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審査請求　未請求　請求項の数58　ＯＬ　（全 15 頁）

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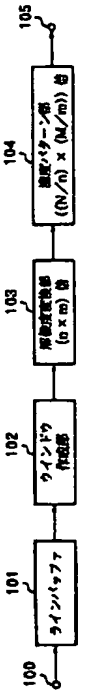
(54)【発明の名称】　画像処理方法とその装置

(57)【要約】
【課題】　従来の画像処理技術では、低解像度で多階調画像をジャギーがなくエッジのはっきりした画質の２値画像に、低コスト、低負荷で、効率よく変換することができなかった。
【解決手段】　第１の多値画像を縦方向にＮ倍、横方向にＭ倍の２値画像に変換する画像処理方法において、第１の多値画像を、縦方向にｎ倍、横方向にｍ倍の第２の多値画像に解像度変換し、第２の多値画像を、縦方向にＮ／ｎ倍、横方向にＭ／ｍ倍の複数画素の組み合わせで第２の多値画像の濃度を表現した２値画像に変換する（１０４）。



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【特許請求の範囲】

【請求項１】　第１の多値画像を縦方向にＮ倍、横方向にＭ倍の２値画像に変換する画像処理方法であって、
前記第１の多値画像を、縦方向にｎ倍、横方向にｍ倍の第２の多値画像に解像度変換する解像度変換工程と、
前記第２の多値画像を、縦方向にＮ／ｎ倍、横方向にＭ／ｍ倍の複数画素の組み合わせで前記第２の多値画像の濃度を表現した２値画像に変換する濃度パタン変換工程とを備えることを特徴とする画像処理方法。

【請求項２】　前記解像度変換工程は、
前記第１の多値画像の最大濃度値と最小濃度値を検出する最大値／最小値検出工程と、
前記検出された最大濃度値と最小濃度値に基づき、２値化のための閾値を生成する２値化閾値生成工程と、
前記多値画像を補間して、縦方向にＮ倍、横方向にＭ倍の第２の多値画像を生成する第２の多値画像生成工程と、
前記第２の多値画像を前記閾値に基づき２値化して、前記２値化された画像を前記検出された最大濃度値と最小濃度値を代入して２値画像とする２値化工程と、
前記２値化工程で生成された２値画像と前記第２の多値画像生成工程で生成された第２の多値画像を所定の配分比率で合成する合成工程とを備えることを特徴とする請求項１に記載の画像処理方法。

【請求項３】　前記多値画像は、所定の多値画像から所定サイズのウインドウ単位に切り出された画像であることを特徴とする請求項１に記載の画像処理方法。

【請求項４】　多値画像を縦方向にＮ倍、横方向にＭ倍の２値画像に変換する画像処理方法であって、
前記多値画像を、縦方向にｎ倍、横方向にｍ倍の第１の２値画像に解像度変換する解像度変換工程と、
前記第１の２値画像を、縦方向にＮ／ｎ倍、横方向にＭ／ｍ倍の複数画素の組み合わせで前記第１の２値画像の濃度を表現した第２の２値画像に変換する濃度パタン変換工程とを備えることを特徴とする画像処理方法。

【請求項５】　前記解像度変換工程は、
前記多値画像の最大濃度値と最小濃度値を検出する最大値／最小値検出工程と、　前記検出された最大濃度値と最小濃度値に基づき、２値化のための閾値を生成する２値化閾値生成工程と、
前記多値画像を補間して、縦方向にＮ倍、横方向にＭ倍の第２の多値画像を生成する第２の多値画像生成工程と、
前記第２の多値画像を前記閾値に基づき、前記検出された最大濃度値と最小濃度値で２値化する２値化工程とを備えることを特徴とする請求項４に記載の画像処理方法。

【請求項６】　前記濃度パタン変換工程は、
縦方向にＮ／ｎ倍、横方向にＭ／ｍ倍の複数画素の組み合わせで、前記第１の２値画像の画素の濃度を表現した

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第２の２値画像に変換することを特徴とする請求項１に記載の画像処理方法。

【請求項７】　前記多値画像は、所定の多値画像から所定サイズのウインドウ単位に切り出された画像であることを特徴とする請求項４に記載の画像処理方法。

【請求項８】　前記解像度変換工程と前記濃度パタン変換工程を、前記所定の多値画像全体について繰り返し実行させる繰り返し実行制御工程をさらに備えることを特徴とする請求項７に記載の画像処理方法。

【請求項９】　多値画像を縦方向にＮ倍、横方向にＭ倍の２値画像に変換する画像処理方法であって、
前記多値画像のエッジ勾配と前記ＮとＭに基づいて、パラメータｎ，ｍをそれぞれ決定するパラメータ決定工程と、
前記多値画像を縦方向にｎ倍、横方向にｍ倍の第１の２値画像に解像度変換する解像度変換工程と、
前記第１の２値画像を、縦方向にＮ／ｎ倍、横方向にＭ／ｍ倍の複数画素の組み合わせで前記第１の２値画像の濃度を表現した第２の２値画像に変換する濃度パタン変換工程とを備えることを特徴とする画像処理方法。

【請求項１０】　前記パラメータｎ、ｍは、前記エッジ勾配が大きければ、前記Ｎ、Ｍに対して相対的に大きくそれぞれ決定されることを特徴とする請求項９に記載の画像処理方法。

【請求項１１】　前記パラメータｎ、ｍは、前記エッジ勾配の増加方向に対して、階段状に増加するように決定されることを特徴とする請求項９に記載の画像処理方法。

【請求項１２】　前記解像度変換工程は、
前記多値画像の最大濃度値と最小濃度値を検出する最大値／最小値検出工程と、
前記検出された最大濃度値と最小濃度値に基づき、２値化のための閾値を生成する２値化閾値生成工程と、
前記多値画像を補間して、縦方向にＮ倍、横方向にＭ倍の第２の多値画像を生成する第２の多値画像生成工程と、
前記第２の多値画像を前記閾値に基づき、前記検出された最大濃度値と最小濃度値で２値化する２値化工程とを備えることを特徴とする請求項９に記載の画像処理方法。

【請求項１３】　前記濃度パタン変換工程は、
縦方向にＮ／ｎ倍、横方向にＭ／ｍ倍の複数画素の組み合わせで、前記第１の２値画像の画素の濃度を表現した第２の２値画像に変換することを特徴とする請求項９に記載の画像処理方法。

【請求項１４】　前記多値画像は、所定の多値画像から所定サイズのウインドウ単位に切り出された画像であることを特徴とする請求項９に記載の画像処理方法。

【請求項１５】　前記請求項６に記載の画像処理方法の各工程を、前記所定の多値画像全体について繰り返し実

行させる繰り返し実行制御工程をさらに備えることを特徴とする請求項１４に記載の画像処理方法。

【請求項１６】　多値画像を縦方向にＮ倍、横方向にＭ倍の２値画像に変換する画像処理方法であって、

前記多値画像の濃度の最大値と最小値の差Ｃと前記ＮとＭに基づいて、パラメータｎ，ｍをそれぞれ決定するパラメータ決定工程と、

多値画像を縦方向にｎ倍、横方向にｍ倍の第１の２値画像に解像度変換する解像度変換工程と、

前記第１の２値画像を、縦方向にＮ／ｎ倍、横方向にＭ／ｍ倍の複数画素の組み合わせで前記第１の２値画像の濃度を表現した第２の２値画像に変換する濃度パタン変換工程とを備えることを特徴とする画像処理方法。

【請求項１７】　前記パラメータｎ、ｍは、前記差Ｃが大きければ、前記Ｎ、Ｍに対して相対的に大きくそれぞれ決定されることを特徴とする請求項１６に記載の画像処理方法。

【請求項１８】　前記パラメータｎ、ｍは、前記差Ｃの増加方向に対して、階段状に増加するように決定されることを特徴とする請求項１６に記載の画像処理方法。

【請求項１９】　前記解像度変換工程は、

前記多値画像の最大濃度値と最小濃度値を検出する最大値／最小値検出工程と、

前記検出された最大濃度値と最小濃度値に基づき、２値化のための閾値を生成する２値化閾値生成工程と、

前記多値画像を補間して、縦方向にＮ倍、横方向にＭ倍の第２の多値画像を生成する第２の多値画像生成工程と、

前記第２の多値画像を前記閾値に基づき、前記検出された最大濃度値と最小濃度値で２値化する２値化工程とを備えることを特徴とする請求項１６に記載の画像処理方法。

【請求項２０】　前記濃度パタン変換工程は、

縦方向にＮ／ｎ倍、横方向にＭ／ｍ倍の複数画素の組み合わせで、前記第１の２値画像の画素の濃度を表現した第２の２値画像に変換することを特徴とする請求項１６に記載の画像処理方法。

【請求項２１】　前記多値画像は、所定の多値画像から所定サイズのウインドウ単位に切り出された画像であることを特徴とする請求項１６に記載の画像処理方法。

【請求項２２】　前記請求項１３に記載の画像処理方法の各工程を、前記所定の多値画像全体について繰り返し実行させる繰り返し実行制御工程をさらに備えることを特徴とする請求項１６に記載の画像処理方法。

【請求項２３】　多値画像を縦方向にＮ倍、横方向にＭ倍の２値画像に変換する画像処理方法であって、

前記多値画像を縦方向にＮ倍、横方向にＭ倍の第１の２値画像に解像度変換する解像度変換工程と、

前記第１の２値画像をディザ法により、第２の２値画像に変換するディザ変換工程と、

前記多値画像を、縦方向にＮ倍、横方向にＭ倍の複数画素の組み合わせで前記多値画像の濃度を表現した第３の２値画像に変換する濃度パタン変換工程と前記多値画像が所定の勾配以上のエッジを含めば、前記第２の２値画像を選択し、前記多値画像が所定の勾配以上のエッジを含まなければ、前記第３の２値画像を選択する選択工程とを備えることを特徴とする画像処理方法。

【請求項２４】　前記解像度変換工程は、

前記多値画像の最大濃度値と最小濃度値を検出する最大値／最小値検出工程と、

前記検出された最大濃度値と最小濃度値に基づき、２値化のための閾値を生成する２値化閾値生成工程と、

前記多値画像を補間して、縦方向にＮ倍、横方向にＭ倍の第２の多値画像を生成する第２の多値画像生成工程と、

前記第２の多値画像を前記閾値に基づき、前記検出された最大濃度値と最小濃度値で２値化する２値化工程とを備えることを特徴とする請求項２３に記載の画像処理方法。

【請求項２５】　前記多値画像は、所定の多値画像から所定サイズのウインドウ単位に切り出された画像であることを特徴とする請求項２０に記載の画像処理方法。

【請求項２６】　請求項２５に記載の画像処理方法の各工程を、前記所定の多値画像全体について繰り返し実行させる繰り返し実行制御工程をさらに備えることを特徴とする請求項２５に記載の画像処理方法。

【請求項２７】　前記エッジは、前記多値画像に所定のエッジ検出フィルタを作用させることによって得られることを特徴とする請求項９あるいは請求項２３のいづれかに記載の画像処理方法。

【請求項２８】　多値画像を縦方向にＮ倍、横方向にＭ倍の２値画像に変換する画像処理装置であって、

前記多値画像を、縦方向にｎ倍、横方向にｍ倍の第１の２値画像に解像度変換する解像度変換手段と、

前記第１の２値画像を、縦方向にＮ／ｎ倍、横方向にＭ／ｍ倍の複数画素の組み合わせで前記第１の２値画像の濃度を表現した第２の２値画像に変換する濃度パタン変換手段とを備えることを特徴とする画像処理装置。

【請求項２９】　前記解像度変換手段は、

前記多値画像の最大濃度値と最小濃度値を検出する最大値／最小値検出手段と、

前記検出された最大濃度値と最小濃度値に基づき、２値化のための閾値を生成する２値化閾値生成手段と、

前記多値画像を補間して、縦方向にＮ倍、横方向にＭ倍の第２の多値画像を生成する第２の多値画像生成手段と、

前記第２の多値画像を前記閾値に基づき、前記検出された最大濃度値と最小濃度値で２値化する２値化手段とを備えることを特徴とする請求項２８に記載の画像処理装置。

【請求項３０】　前記濃度パタン変換手段は、
縦方向にＮ／ｎ倍、横方向にＭ／ｍ倍の複数画素の組み合わせで、前記第１の２値画像の画素の濃度を表現した第２の２値画像に変換することを特徴とする請求項２８に記載の画像処理装置。
【請求項３１】　前記多値画像は、所定の多値画像から所定サイズのウインドウ単位に切り出された画像であることを特徴とする請求項２８に記載の画像処理装置。
【請求項３２】　前記解像度変換手段と前記濃度パタン変換手段を、前記所定の多値画像全体について繰り返し実行させる繰り返し実行制御手段をさらに備えることを特徴とする請求項３１に記載の画像処理装置。
【請求項３３】　多値画像を縦方向にＮ倍、横方向にＭ倍の２値画像に変換する画像処理装置であって、
前記多値画像のエッジ勾配と前記ＮとＭに基づいて、パラメータｎ，ｍをそれぞれ決定するパラメータ決定手段と、
前記多値画像を縦方向にｎ倍、横方向にｍ倍の第１の２値画像に解像度変換する解像度変換手段と、
前記第１の２値画像を、縦方向にＮ／ｎ倍、横方向にＭ／ｍ倍の複数画素の組み合わせで前記第１の２値画像の濃度を表現した第２の２値画像に変換する濃度パタン変換手段とを備えることを特徴とする画像処理装置。
【請求項３４】　前記パラメータｎ、ｍは、前記エッジ勾配が大きければ、前記Ｎ、Ｍに対して相対的に大きくそれぞれ決定されることを特徴とする請求項３３に記載の画像処理装置。
【請求項３５】　前記パラメータｎ、ｍは、前記エッジ勾配の増加方向に対して、階段状に増加するように決定されることを特徴とする請求項３３に記載の画像処理装置。
【請求項３６】　前記解像度変換手段は、
前記多値画像の最大濃度値と最小濃度値を検出する最大値／最小値検出手段と、
前記検出された最大濃度値と最小濃度値に基づき、２値化のための閾値を生成する２値化閾値生成手段と、
前記多値画像を補間して、縦方向にＮ倍、横方向にＭ倍の第２の多値画像を生成する第２の多値画像生成手段と、
前記第２の多値画像を前記閾値に基づき、前記検出された最大濃度値と最小濃度値で２値化する２値化手段とを備えることを特徴とする請求項３３に記載の画像処理装置。
【請求項３７】　前記濃度パタン変換手段は、
縦方向にＮ／ｎ倍、横方向にＭ／ｍ倍の複数画素の組み合わせで、前記第１の２値画像の画素の濃度を表現した第２の２値画像に変換することを特徴とする請求項３３に記載の画像処理装置。
【請求項３８】　前記多値画像は、所定の多値画像から所定サイズのウインドウ単位に切り出された画像であることを特徴とする請求項３３に記載の画像処理装置。

【請求項３９】　前記請求項３０に記載の画像処理装置の各手段を、前記所定の多値画像全体について繰り返し実行させる繰り返し実行制御手段をさらに備えることを特徴とする請求項３８に記載の画像処理装置。
【請求項４０】　多値画像を縦方向にＮ倍、横方向にＭ倍の２値画像に変換する画像処理装置であって、
前記多値画像の濃度の最大値と最小値の差Ｃと前記ＮとＭに基づいて、パラメータｎ，ｍをそれぞれ決定するパラメータ決定手段と、
多値画像を縦方向にｎ倍、横方向にｍ倍の第１の２値画像に解像度変換する解像度変換手段と、
前記第１の２値画像を、縦方向にＮ／ｎ倍、横方向にＭ／ｍ倍の複数画素の組み合わせで前記第１の２値画像の濃度を表現した第２の２値画像に変換する濃度パタン変換手段とを備えることを特徴とする画像処理装置。
【請求項４１】　前記パラメータｎ、ｍは、前記差Ｃが大きければ、前記Ｎ、Ｍに対して相対的に大きくそれぞれ決定されることを特徴とする請求項４０に記載の画像処理装置。
【請求項４２】　前記パラメータｎ、ｍは、前記差Ｃの増加方向に対して、階段状に増加するように決定されることを特徴とする請求項４０に記載の画像処理装置。
【請求項４３】　前記解像度変換手段は、
前記多値画像の最大濃度値と最小濃度値を検出する最大値／最小値検出手段と、
前記検出された最大濃度値と最小濃度値に基づき、２値化のための閾値を生成する２値化閾値生成手段と、
前記多値画像を補間して、縦方向にＮ倍、横方向にＭ倍の第２の多値画像を生成する第２の多値画像生成手段と、
前記第２の多値画像を前記閾値に基づき、前記検出された最大濃度値と最小濃度値で２値化する２値化手段とを備えることを特徴とする請求項４０に記載の画像処理装置。
【請求項４４】　前記濃度パタン変換手段は、
縦方向にＮ／ｎ倍、横方向にＭ／ｍ倍の複数画素の組み合わせで、前記第１の２値画像の画素の濃度を表現した第２の２値画像に変換することを特徴とする請求項４０に記載の画像処理装置。
【請求項４５】　前記多値画像は、所定の多値画像から所定サイズのウインドウ単位に切り出された画像であることを特徴とする請求項４０に記載の画像処理装置。
【請求項４６】　前記請求項１３に記載の画像処理装置の各手段を、前記所定の多値画像全体について繰り返し実行させる繰り返し実行制御手段をさらに備えることを特徴とする請求項４０に記載の画像処理装置。
【請求項４７】　多値画像を縦方向にＮ倍、横方向にＭ倍の２値画像に変換する画像処理装置であって、
前記多値画像を縦方向にＮ倍、横方向にＭ倍の第１の２

値画像に解像度変換する解像度変換手段と、
前記第１の２値画像をディザ法により、第２の２値画像に変換するディザ変換手段と、
前記多値画像を、縦方向にＮ倍、横方向にＭ倍の複数画素の組み合わせで前記多値画像の濃度を表現した第３の２値画像に変換する濃度パタン変換手段と前記多値画像が所定の勾配以上のエッジを含めば、前記第２の２値画像を選択し、前記多値画像が所定の勾配以上のエッジを含まなければ、前記第３の２値画像を選択する選択手段とを備えることを特徴とする画像処理装置。
【請求項４８】　前記解像度変換手段は、
前記多値画像の最大濃度値と最小濃度値を検出する最大値／最小値検出手段と、
前記検出された最大濃度値と最小濃度値に基づき、２値化のための閾値を生成する２値化閾値生成手段と、
前記多値画像を補間して、縦方向にＮ倍、横方向にＭ倍の第２の多値画像を生成する第２の多値画像生成手段と、
前記第２の多値画像を前記閾値に基づき、前記検出された最大濃度値と最小濃度値で２値化する２値化手段とを備えることを特徴とする請求項４７に記載の画像処理装置。
【請求項４９】　前記多値画像は、所定の多値画像から所定サイズのウインドウ単位に切り出された画像であることを特徴とする請求項４７に記載の画像処理装置。
【請求項５０】　請求項４９に記載の画像処理装置の各手段を、前記所定の多値画像全体について繰り返し実行させる繰り返し実行制御手段をさらに備えることを特徴とする請求項４９に記載の画像処理装置。
【請求項５１】　前記エッジは、前記多値画像に所定のエッジ検出フィルタを作用させることによって得られることを特徴とする請求項３３あるいは請求項４７のいづれかに記載の画像処理装置。
【請求項５２】　コンピュータプログラム製品であって、
画像処理装置において、多値画像を縦方向にＮ倍、横方向にＭ倍の２値画像に変換する、コンピュータ読み取り可能なプログラムコード手段を有する媒体を備え、前記コンピュータプログラム製品は、
前記多値画像を、縦方向にｎ倍、横方向にｍ倍の第１の２値画像に解像度変換する、コンピュータ読み取り可能なプログラムコード手段と、
前記第１の２値画像を、縦方向にＮ／ｎ倍、横方向にＭ／ｍ倍の複数画素の組み合わせで前記第１の２値画像の濃度を表現した第２の２値画像に変換する、コンピュータ読み取り可能なプログラムコード手段とを備えることを特徴とする。
【請求項５３】　コンピュータプログラム製品であって、
画像処理装置において、多値画像を縦方向にＮ倍、横方向にＭ倍の２値画像に変換する、コンピュータ読み取り可能なプログラムコード手段を有する媒体を備え、前記コンピュータプログラム製品は、
前記多値画像のエッジ勾配と前記ＮとＭに基づいて、パラメータｎ，ｍをそれぞれ決定する、コンピュータ読み取り可能なプログラムコード手段と、
前記多値画像を縦方向にｎ倍、横方向にｍ倍の第１の２値画像に解像度変換する、コンピュータ読み取り可能なプログラムコード手段と、
前記第１の２値画像を、縦方向にＮ／ｎ倍、横方向にＭ／ｍ倍の複数画素の組み合わせで前記第１の２値画像の濃度を表現した第２の２値画像に変換する、コンピュータ読み取り可能なプログラムコード手段とを備えることを特徴とする。
【請求項５４】　コンピュータプログラム製品であって、
画像処理装置において、多値画像を縦方向にＮ倍、横方向にＭ倍の２値画像に変換する、コンピュータ読み取り可能なプログラムコード手段を有する媒体を備え、前記コンピュータプログラム製品は、
前記多値画像の濃度の最大値と最小値の差Ｃと前記ＮとＭに基づいて、パラメータｎ，ｍをそれぞれ決定する、コンピュータ読み取り可能なプログラムコード手段と、
多値画像を縦方向にｎ倍、横方向にｍ倍の第１の２値画像に解像度変換する、コンピュータ読み取り可能なプログラムコード手段と、
前記第１の２値画像を、縦方向にＮ／ｎ倍、横方向にＭ／ｍ倍の複数画素の組み合わせで前記第１の２値画像の濃度を表現した第２の２値画像に変換する、コンピュータ読み取り可能なプログラムコード手段とを備えることを特徴とする。
【請求項５５】　コンピュータプログラム製品であって、
画像処理装置において、多値画像を縦方向にＮ倍、横方向にＭ倍の２値画像に変換する、コンピュータ読み取り可能なプログラムコード手段を有する媒体を備え、前記コンピュータプログラム製品は、
前記多値画像を縦方向にＮ倍、横方向にＭ倍の第１の２値画像に解像度変換する、コンピュータ読み取り可能なプログラムコード手段と、
前記第１の２値画像をディザ法により、第２の２値画像に変換する、コンピュータ読み取り可能なプログラムコード手段と、
前記多値画像を、縦方向にＮ倍、横方向にＭ倍の複数画素の組み合わせで前記多値画像の濃度を表現した第３の２値画像に変換する、コンピュータ読み取り可能なプログラムコード手段と、
前記多値画像が所定の勾配以上のエッジを含めば、前記第２の２値画像を選択し、前記多値画像が所定の勾配以上のエッジを含まなければ、前記第３の２値画像を選択

する、コンピュータ読み取り可能なプログラムコード手段とを備えることを特徴とする。

【請求項５６】　第１の多値画像を縦方向にＮ倍、横方向にＭ倍の２値画像に変換する画像処理装置であって、
前記第１の多値画像を、縦方向にｎ倍、横方向にｍ倍の第２の多値画像に解像度変換する解像度変換手段と、
前記第２の多値画像を、縦方向にＮ／ｎ倍、横方向にＭ／ｍ倍の複数画素の組み合わせで前記第２の多値画像の濃度を表現した２値画像に変換する濃度パタン変換手段とを備えることを特徴とする画像処理装置。

【請求項５７】　前記解像度変換手段は、
前記第１の多値画像の最大濃度値と最小濃度値を検出する最大値／最小値検出手段と、
前記検出された最大濃度値と最小濃度値に基づき、２値化のための閾値を生成する２値化閾値生成手段と、
前記多値画像を補間して、縦方向にＮ倍、横方向にＭ倍の第２の多値画像を生成する第２の多値画像生成手段と、
前記第２の多値画像を前記閾値に基づき２値化して、前記２値化された画像を前記検出された最大濃度値と最小濃度値を代入して２値画像とする２値化手段と、
前記２値化手段で生成された２値画像と前記第２の多値画像生成手段で生成された第２の多値画像を所定の配分比率で合成する合成手段とを備えることを特徴とする請求項５６に記載の画像処理装置。

【請求項５８】　前記多値画像は、所定の多値画像から所定サイズのウインドウ単位に切り出された画像であることを特徴とする請求項５６に記載の画像処理装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、画像処理方法とその装置、特に、低解像度で多階調の画像情報を２値化する処理方法とその装置に関する。

【０００２】

【従来の技術】従来より、入力した低解像の多階調情報を高解像情報の２値情報に変換する方法として、様々な方法が提案されている。最も、一般的なのは、濃度パターン法と呼ばれるもので、入力した１画素の階調情報を、２値化した場合の”１”になる画素の数によって所定の領域で階調を表現する方法である。

【０００３】この方法では、画素数が増加するために、画像サイズが大きくなり、入力解像度と異なる出力解像度を実現できる。しかし、この方法では、複数の画素を１画素の階調性を向上させるために用いているだけで、実際の解像性が向上するわけではない。そこで、この濃度パターン法を改良して、解像性を向上させようとする提案が古くよりなされてきた。

【０００４】そのうち主な方法として、ディザ法で用いられている方法と同様に、濃度パターンに対する変換パターンを適応的に切り替える方法がある。例えば、平坦部では、”１”となる画素を中央から埋めていく、いわゆる集中型のパターンを用い、エッジ部では、解像性を向上させるために”１”となる画素を散らせて配置させる、いわゆる分散型のパターンを用いる方法などがある。

【０００５】また、濃度パターン法とは異なるが、エッジ部での拡大、及び２値化処理では、ＵＳＰ４３５５３３７にて提案されているように、隣接画素の情報から、”１”となる画素をうまく配置させて、スムーズなジャギーのないエッジを作成する方法や、ＵＳＰ４７４２３９９にて提案されているように、ＬＵＴを用いて隣接画素の状態から斜線等が滑らかになるように設定する方法がある。

【０００６】また、濃度パターンを用いない方法では、多階調の情報のまま、何らかの方法で解像度変換した後に、ディザ法や誤差拡散法などの拡大処理を伴わない等倍の擬似中間調処理を施す方法が一般的である。

【０００７】

【発明が解決しようとする課題】しかし、上記従来例では、以下に示す欠点があった。まず、濃度パターン法でのパターンの適応型での目的は、濃度パターンによる擬似中間調処理時でのサブマトリクスを利用したときに生じる情報の損失を救う目的のものであり、もともとの低解像の情報から、なんら解像性が向上するものではない。

【０００８】例えば、入力した低解像度の画像中に斜線があったとしても、この方法では高解像度でジャギーのない斜線の作成は望めない。サブマトリクスを利用した時に、階調性と解像性が背反条件になるが、これを適応的に切り替えるにすぎない。また、前述した低解像度での値を基に”１”になる画素を、演算やＬＵＴを用いてうまく配置させる方法であるが、例えば、自然画像などの中間調で、このような処理をしてしまうと、”１”の画素がかたまるために、自然画像の有する滑らかなエッジが全て縁取りされた画像になってしまう。

【０００９】また、前述の従来例では、イメージスキャナなどの画像読み取り装置や、ＦＡＸ等を通してエッジに対してＭＴＦ特性（Modulation transfer function）のかかった情報を考慮しているが、例えば、プリンタ等で用いられる場合には、ホストコンピュータから直に情報が送信されることになる。コンピュータで人工的に作成された文字、線画像などではエッジに鈍りがない、いわゆるナイフエッジのために、低解像度中の注目画素値自体を変化させなくてはジャギーの生じない高解像への解像度変換は難しい。

【００１０】また、多階調の状態での解像度変換後に、擬似中間調処理をすること自体は、画質的には問題がないが、高解像にした後では画像サイズが数倍から数十倍にもなるため、コスト的、処理速度的に非常に負荷がかかり効率的ではない。例えば、１２００ｄｐｉ×１２０

０ｄｐｉで出力可能な１色あたり２値のカラープリンタを想定する。このプリンタがＡ４サイズの画像を出力しようとした場合には、１２００ｄｐｉ×１２００ｄｐｉで１色あたり８ｂｉｔの画像情報を入力した場合、数百Ｍバイトの情報量が必要となり現実的ではない。そこで、低解像度の画像情報を入力し、解像度変換、及び２値化処理をして出力する構成を取る。

【００１１】ここで例えば、７５ｄｐｉ×７５ｄｐｉで１色あたり８ｂｉｔの画像情報の入力を考える。この場合、入力情報量は、１２００ｄｐｉ×１２００ｄｐｉ入力の（１／１６）×（１／１６）の情報量で済み、現実的である。この入力画像を（１６×１６）倍に解像度変換して、２値化処理をした値で出力するわけであるが、前述した実施の形態の様に、階調数を減らさずに全て解像度変換した後に、擬似中間調処理を施すとなると、結局は、大量の情報を扱わなくてはならず、処負荷は非常に重くなる。

【００１２】本発明は、上記従来例に鑑みてなされたもので、低解像度で多階調画像をジャギーがなくエッジのはっきりした画質の２値画像に、低コスト、低負荷で、効率よく変換できる画像処理方法とその装置を提供することを目的とする。

【００１３】

【課題を解決するための手段】上記目的を達成するため、本発明の画像処理方法とその装置、並びにそのコンピュータプログラム製品は以下の構成を備える。即ち、第１の多値画像を縦方向にＮ倍、横方向にＭ倍の２値画像に変換する画像処理方法であって、前記第１の多値画像を、縦方向にｎ倍、横方向にｍ倍の第２の多値画像に解像度変換する解像度変換工程と、前記第２の多値画像を、縦方向にＮ／ｎ倍、横方向にＭ／ｍ倍の複数画素の組み合わせで前記第２の多値画像の濃度を表現した２値画像に変換する濃度パタン変換工程とを備える。

【００１４】また、別の発明は、多値画像を縦方向にＮ倍、横方向にＭ倍の２値画像に変換する画像処理方法であって、前記多値画像を、縦方向にｎ倍、横方向にｍ倍の第１の２値画像に解像度変換する解像度変換工程と、前記第１の２値画像を、縦方向にＮ／ｎ倍、横方向にＭ／ｍ倍の複数画素の組み合わせで前記第１の２値画像の濃度を表現した第２の２値画像に変換する濃度パタン変換工程とを備える。

【００１５】また、別の発明は、多値画像を縦方向にＮ倍、横方向にＭ倍の２値画像に変換する画像処理方法であって、前記多値画像のエッジ勾配と前記ＮとＭに基づいて、パラメータｎ，ｍをそれぞれ決定するパラメータ決定工程と、前記多値画像を縦方向にｎ倍、横方向にｍ倍の第１の２値画像に解像度変換する解像度変換工程と、前記第１の２値画像を、縦方向にＮ／ｎ倍、横方向にＭ／ｍ倍の複数画素の組み合わせで前記第１の２値画像の濃度を表現した第２の２値画像に変換する濃度パタン変換工程とを備える。

【００１６】また、別の発明は、多値画像を縦方向にＮ倍、横方向にＭ倍の２値画像に変換する画像処理方法であって、前記多値画像の濃度の最大値と最小値の差Ｃと前記ＮとＭに基づいて、パラメータｎ，ｍをそれぞれ決定するパラメータ決定工程と、多値画像を縦方向にｎ倍、横方向にｍ倍の第１の２値画像に解像度変換する解像度変換工程と、前記第１の２値画像を、縦方向にＮ／ｎ倍、横方向にＭ／ｍ倍の複数画素の組み合わせで前記第１の２値画像の濃度を表現した第２の２値画像に変換する濃度パタン変換工程とを備える。

【００１７】また、別の発明は、多値画像を縦方向にＮ倍、横方向にＭ倍の２値画像に変換する画像処理方法であって、前記多値画像を縦方向にＮ倍、横方向にＭ倍の第１の２値画像に解像度変換する解像度変換工程と、前記第１の２値画像をディザ法により、第２の２値画像に変換するディザ変換工程と、前記多値画像を、縦方向にＮ倍、横方向にＭ倍の複数画素の組み合わせで前記多値画像の濃度を表現した第３の２値画像に変換する濃度パタン変換工程と前記多値画像が所定の勾配以上のエッジを含めば、前記第２の２値画像を選択し、前記多値画像が所定の勾配以上のエッジを含まなければ、前記第３の２値画像を選択する選択工程とを備える。

【００１８】また、別の発明は、多値画像を縦方向にＮ倍、横方向にＭ倍の２値画像に変換する画像処理装置であって、前記多値画像を、縦方向にｎ倍、横方向にｍ倍の第１の２値画像に解像度変換する解像度変換手段と、前記第１の２値画像を、縦方向にＮ／ｎ倍、横方向にＭ／ｍ倍の複数画素の組み合わせで前記第１の２値画像の濃度を表現した第２の２値画像に変換する濃度パタン変換手段とを備える。

【００１９】また、別の発明は、多値画像を縦方向にＮ倍、横方向にＭ倍の２値画像に変換する画像処理装置であって、前記多値画像のエッジ勾配と前記ＮとＭに基づいて、パラメータｎ，ｍをそれぞれ決定するパラメータ決定手段と、前記多値画像を縦方向にｎ倍、横方向にｍ倍の第１の２値画像に解像度変換する解像度変換手段と、前記第１の２値画像を、縦方向にＮ／ｎ倍、横方向にＭ／ｍ倍の複数画素の組み合わせで前記第１の２値画像の濃度を表現した第２の２値画像に変換する濃度パタン変換手段とを備える。

【００２０】また、別の発明は、多値画像を縦方向にＮ倍、横方向にＭ倍の２値画像に変換する画像処理装置であって、前記多値画像の濃度の最大値と最小値の差Ｃと前記ＮとＭに基づいて、パラメータｎ，ｍをそれぞれ決定するパラメータ決定手段と、多値画像を縦方向にｎ倍、横方向にｍ倍の第１の２値画像に解像度変換する解像度変換手段と、前記第１の２値画像を、縦方向にＮ／ｎ倍、横方向にＭ／ｍ倍の複数画素の組み合わせで前記第１の２値画像の濃度を表現した第２の２値画像に変換

する濃度パタン変換手段とを備える。

【００２１】また、別の発明は、多値画像を縦方向にＮ倍、横方向にＭ倍の２値画像に変換する画像処理装置であって、前記多値画像を縦方向にＮ倍、横方向にＭ倍の第１の２値画像に解像度変換する解像度変換手段と、前記第１の２値画像をディザ法により、第２の２値画像に変換するディザ変換手段と、前記多値画像を、縦方向にＮ倍、横方向にＭ倍の複数画素の組み合わせで前記多値画像の濃度を表現した第３の２値画像に変換する濃度パタン変換手段と前記多値画像が所定の勾配以上のエッジを含めば、前記第２の２値画像を選択し、前記多値画像が所定の勾配以上のエッジを含まなければ、前記第３の２値画像を選択する選択手段とを備える。

【００２２】また、別の発明は、コンピュータプログラム製品であって、画像処理装置において、多値画像を縦方向にＮ倍、横方向にＭ倍の２値画像に変換する、コンピュータ読み取り可能なプログラムコード手段を有する媒体を備え、前記コンピュータプログラム製品は、前記多値画像を、縦方向にｎ倍、横方向にｍ倍の第１の２値画像に解像度変換する、コンピュータ読み取り可能なプログラムコード手段と、前記第１の２値画像を、縦方向にＮ／ｎ倍、横方向にＭ／ｍ倍の複数画素の組み合わせで前記第１の２値画像の濃度を表現した第２の２値画像に変換する、コンピュータ読み取り可能なプログラムコード手段とを備える。

【００２３】また、別の発明は、コンピュータプログラム製品であって、画像処理装置において、多値画像を縦方向にＮ倍、横方向にＭ倍の２値画像に変換する、コンピュータ読み取り可能なプログラムコード手段を有する媒体を備え、前記コンピュータプログラム製品は、前記多値画像のエッジ勾配と前記ＮとＭに基づいて、パラメータｎ，ｍをそれぞれ決定する、コンピュータ読み取り可能なプログラムコード手段と、前記多値画像を縦方向にｎ倍、横方向にｍ倍の第１の２値画像に解像度変換する、コンピュータ読み取り可能なプログラムコード手段と、前記第１の２値画像を、縦方向にＮ／ｎ倍、横方向にＭ／ｍ倍の複数画素の組み合わせで前記第１の２値画像の濃度を表現した第２の２値画像に変換する、コンピュータ読み取り可能なプログラムコード手段とを備える。

【００２４】また、別の発明は、コンピュータプログラム製品であって、画像処理装置において、多値画像を縦方向にＮ倍、横方向にＭ倍の２値画像に変換する、コンピュータ読み取り可能なプログラムコード手段を有する媒体を備え、前記コンピュータプログラム製品は、前記多値画像の濃度の最大値と最小値の差Ｃと前記ＮとＭに基づいて、パラメータｎ，ｍをそれぞれ決定する、コンピュータ読み取り可能なプログラムコード手段と、多値画像を縦方向にｎ倍、横方向にｍ倍の第１の２値画像に解像度変換する、コンピュータ読み取り可能なプログラムコード手段と、前記第１の２値画像を、縦方向にＮ／ｎ倍、横方向にＭ／ｍ倍の複数画素の組み合わせで前記第１の２値画像の濃度を表現した第２の２値画像に変換する、コンピュータ読み取り可能なプログラムコード手段とを備える。

【００２５】また、別の発明は、コンピュータプログラム製品であって、画像処理装置において、多値画像を縦方向にＮ倍、横方向にＭ倍の２値画像に変換する、コンピュータ読み取り可能なプログラムコード手段を有する媒体を備え、前記コンピュータプログラム製品は、前記多値画像を縦方向にＮ倍、横方向にＭ倍の第１の２値画像に解像度変換する、コンピュータ読み取り可能なプログラムコード手段と、前記第１の２値画像をディザ法により、第２の２値画像に変換する、コンピュータ読み取り可能なプログラムコード手段と、前記多値画像を、縦方向にＮ倍、横方向にＭ倍の複数画素の組み合わせで前記多値画像の濃度を表現した第３の２値画像に変換する、コンピュータ読み取り可能なプログラムコード手段と、前記多値画像が所定の勾配以上のエッジを含めば、前記第２の２値画像を選択し、前記多値画像が所定の勾配以上のエッジを含まなければ、前記第３の２値画像を選択する、コンピュータ読み取り可能なプログラムコード手段とを備える。

【００２６】また、別の発明は、第１の多値画像を縦方向にＮ倍、横方向にＭ倍の２値画像に変換する画像処理装置であって、前記第１の多値画像を、縦方向にｎ倍、横方向にｍ倍の第２の多値画像に解像度変換する解像度変換手段と、前記第２の多値画像を、縦方向にＮ／ｎ倍、横方向にＭ／ｍ倍の複数画素の組み合わせで前記第２の多値画像の濃度を表現した２値画像に変換する濃度パタン変換手段とを備える。

【００２７】

【実施の形態】

＜第１の実施の形態＞図１は、本発明にかかる第１の実施の形態を表すブロック図である。本発明にかかる実施の形態の画像処理装置は、主としてプリンタ等の画像出力装置内部に具備することが効率的であるが、画像出力装置以外の画像処理装置、ホストコンピュータ内のアプリケーションソフト、または、プリンタドライバソフトとして内蔵することも可能である。

【００２８】図１のブロック図に沿って本実施の形態の動作手順を説明していく。本実施の形態では、入力した１画素あたり多値の画像情報を、縦Ｎ倍、横Ｍ倍の２値の画像情報に変換する例について述べる。図１中、１００は入力端子を示し、低解像の画像情報が入力される。この低解像情報は、ラインバッファ１０１により、数ライン分格納、保持される。この数ライン分の画像情報を基に、１０２は、ウインドウ作成部であり、注目画素を中心とした（Ｘ×Ｙ）画素単位の参照画素であるウインドウを作成する。１０３は、解像度変換部であり、ウイ

ンドウ内の画素値を用いて注目１画素を複数画素に拡張する。

【００２９】ここで、解像度変換部１０３での拡大率を縦ｎ倍、横ｍ倍とすると、注目１画素が、（ｎ×ｍ）画素に変換される。この変換は、注目画素がＡビットの階調数を有する情報と仮定すると、階調数はＡビットのままで、（ｎ×ｍ）画素分の情報に変換をする。また、ｎ，ｍはそれぞれ、Ｎ，Ｍの整数分の１であり、ｎ≠Ｎ，ｍ≠Ｍとする。

【００３０】１０４は濃度パターン部であり、解像度変換後の多値の１画素から、複数画素の２値情報を作成する手段である。尚、この濃度パターン法は公知の為、詳細説明は省略する。既に入力情報は、解像度変換部１０３で、（ｎ×ｍ）倍されている為に、濃度パターン法により作成する２値情報は、縦（Ｎ／ｎ）倍、横（Ｍ／ｍ）倍で十分となる。

【００３１】解像度変換部１０３、及び濃度パターン部１０４により、結果的にＮ×Ｍ倍された画像情報は、出力端子１０５に送信され、２値出力のプリンタエンジンなどにて出力される。以上の構成において、本発明の一つの特徴は、解像度変換と２値化の為の濃度パターン法を合わせ持つ点にある。

【００３２】濃度パターン法は、２値である画素を複数画素持つことにより、領域で階調を表現するものである。即ち、解像度変換部１０３では、解像性を向上させ、濃度パターン部１０４では階調性を表現する。図２に、解像度変換部１０３の処理構成の一例を示す。図２において、破線でかこんだ部分が解像度変換部に相当する。図中２００は低解像度情報の入力端子であり、２０１に示したウインドウ情報が入力される。

【００３３】２０１において、画素Ｅが注目画素で、一点鎖線で囲んだ部分が注目画素の近傍画素を含むウインドウである。入力端子２００から入力した情報は、線形補間部２０２に送信される。線形補間された情報の例を図３に示す。線形補間処理は、注目画素と近傍画素と、その間の距離に基づいて線形補間を行えばよい。例えば、図３の例では、中心画素Ｅと近傍画素Ａ，Ｂ，Ｄとその間の距離によって、Ｅ，Ａ，Ｂ，Ｄに囲まれた領域の各補間画素の補間値を求めればよい。

【００３４】図３において、破線は各低解像画素を中心としたブロック境界を示し、実線で囲まれた部分が、注目画素Ｅに対するブロックである。また、○印は低解像度情報の画素（観測画素）を、×印は補間画素を示している。また、入力端子２００から入力した低解像度情報は、ＭＡＸ／ＭＩＮ検出部２０３によりウインドウ内の最大値（ＭＡＸ）、最小値（ＭＩＮ）が検出される。検出された最大値情報、最小値情報は閾値決定部２０４に送信され、２種の階調レベルに量子化するための閾値が決定される。本実施の形態では、閾値（ＴＨ）を例えば以下の式により決定する。

【００３５】ＴＨ＝（ＭＡＸ＋ＭＩＮ）／２

決定された閾値情報と、最大値情報、最小値情報は２値化部２０５に送信され、線形補間の施された注目画素Ｅを中心とするブロックの補間情報を２値化する。２値化結果は代入部２０６に送信され、２値化結果が”１”である補間画素（閾値よりも大きな補間画素）には最大値を割り当て、”０”である補間画素（閾値よりも小さい補間画素）には最小値を割り当てる。２０７は出力端子を示し、２０８に示したように、前述した最大値、最小値を２値とする画像が出力される。

【００３６】以上の処理は、主にエッジ部分に対して実行される処理であるが、自然画像等の平坦部分では、前述の最大値、最小値で割り当てた２階調の画像のままでは、階調性の少ない絵画調の画質になってしまう。この場合、線形補間情報（線形補間部２０２からの出力情報）と、この最大値、最小値で割り当てた２階調の画像情報（代入部２０６からの出力情報）との適応的な配分比率による合成により、補間ぼけのない良好な解像度変換を実現することができる。尚、この適応的な配分比率による合成方法の詳細な処理方法は、特願平５－２４４７３７に記載されている方法を用いればよい。

【００３７】尚、この解像度変換は、演算により算出してもよいし、また、ＬＵＴ（ルックアップテーブル）により求めてもよい。さて、入力画像をｎ×ｍ倍に解像度変換した画像情報は、解像性が向上する。そして、次に、階調性を表現するために擬似中間調の処理を行う。画像サイズが、解像度変換により、既にｎ×ｍ倍されているために、濃度パターン法による拡大は（Ｎ／ｎ）×（Ｍ／ｍ）倍で十分である。濃度パターン法によるマトリクスサイズは、拡大率と異ならなくてもよく、サブマトリクスを利用した公知の方法でも階調性向上の為に有効である。

【００３８】このように、入力解像度よりも高解像のプリンタエンジンを有する２値のプリンタなどでは、本実施の形態を用いれば、解像度変換部１０３と、階調性表現部とを切り離して考えることが可能になり、プリンタエンジン特性、及び人間の視覚特性に応じたｎ，ｍの値の最適化設計が実現できる。また、コスト、スピード等の因子を考慮した設計も可能である。

【００３９】本実施の形態で注意したい点は、解像度変換部では、ｎ×ｍ倍にした画素において、入力解像度よりも解像性が向上しなくてはならない点である。もし、解像度変換部の代わりに、ただ、ｎ×ｍ倍に画素数を増すだけの０次補間を用いたと仮定すると、Ｎ×Ｍ倍の濃度パターン法と全く等価になってしまうからである。

＜第２の実施の形態＞図４は、本発明の第２の実施の形態を示す要部ブロック図である。尚、本実施の形態を説明する各図面では、図１と同一部には対しては同一番号を付している。

【００４０】まず、入力端子１００から入力した画像情

報を一時的にラインバッファ１０１に格納させ、処理対象である注目画素周辺の画素群からなるウインドウをウインドウ作成部１０２にて作成する。４００は、ウインドウ内の画素値の状態からウインドウ内の画像にエッジ部分を含むか平坦部分であるのかを評価する評価部である。この評価部４００は、従来より用いられているエッジ検出フィルタを用いる。

【００４１】本実施の形態では、この評価結果に基づいて解像度変換部による倍率であるｎ’，ｍ’の値を動的に変化させることが特徴である。ｎ’，ｍ’の取りうる範囲は以下の通りである。

$1 \leqq n' \leqq N$

$1 \leqq m' \leqq M$

また、図１の実施の形態と同様に、ｎ’，ｍ’はそれぞれN，Mの整数分の１であることが必要である。

【００４２】解像度変換部４０１は、評価部４００により決定されたｎ’，ｍ’の値を入力して、ｎ’×ｍ’倍に解像度変換を施す。濃度パターン部４０２は、解像度変換部４０１と同様に、ｎ’，ｍ’の値を入力して、（（Ｎ／ｎ’）×（Ｍ／ｍ’））倍での濃度パターン法に基づく変換処理を施す。本実施の形態での処理において、図１の実施の形態と異なる点は、、階調性を表現する為の拡大率の比を画像の性質により、解像度変換に伴う拡大率を任意に可変できることに特徴がある。

【００４３】つまり、エッジ部では、階調性は多少犠牲になっても、解像性に伴う拡大率（ｎ’，ｍ’）を大きく取り、また、平坦部では解像度が軽視される為に（ｎ’，ｍ’）の値が小さくなるようにする。次に、この実際の処理例を図５、図６を基づき説明する。一例として、入力画像を１６倍×１６倍に拡大して出力する場合（Ｎ＝Ｍ＝１６）で説明する。これは、例えば、１２００ｄｐｉ×１２００ｄｐｉの２値プリンタのエンジンに、７５ｄｐｉ×７５ｄｐｉ相当の画像情報を入力した場合が対応する。

【００４４】図５（ａ）は、低解像情報のウインドウを示し、中央部の二重枠で囲んだ画素が注目画素を示している。この注目画素の処理は、評価部４００の評価結果により、エッジ部分を含むと判定され、ｎ’＝４，ｍ’＝４と決定されたとする。図５（ｂ）は、４×４のサイズに解像度変換された注目画素を示している。低解像度の入力画像での注目画素値は”２０”であるが、解像度変換部４０１により、図５（ｂ）に示すように、１つの近接画素値である”１７０”の値を持つ画素を複数含みエッジを形成している。

【００４５】図５（ｃ）は、（ｂ）で作成された画素に対して（Ｎ／ｎ’）倍×（Ｍ／ｍ’）倍、即ち４倍×４倍で濃度パターン部４０２での処理が実行された結果を示している。図６（ａ）は、同様に低解像度のウインドウを示す。ここで、評価部４００がこのウインドウの注目画素に関する評価結果により、平坦部と判定し、ｎ’＝１，ｍ’＝１と決定したとする。この場合は、解像度変換部４０１での処理を実行せずに、濃度パターン法により、（Ｎ／ｎ’）倍×（Ｍ／ｍ’）倍、即ち１６倍×１６倍の濃度パターン部での処理が実行され、結果として図６（ｂ）の画像が生成される。

【００４６】図５（ｃ）、図６（ｂ）を比較しても明らかなように出力結果は大きく異なる。従来より提案されている濃度パターンのマトリクスを適応型にするだけでは、このような図５（ｃ）の画像を出力することは不可能である。

＜第２の実施の形態の変形＞図７は、第２の実施の形態の変形例であり、図４の評価部４０１の内部を示すブロック図である。本例では、前述の実施の形態よりも、より精度良く評価して、ｎ’，ｍ’の値の算出に反映しているものである。

【００４７】図７において、破線で囲んである部分が、評価部４０１を示す。７０１は入力部を示し、低解像情報の注目画素を囲むウインドウ情報が入力される。７０２はＭＡＸ／ＭＩＮ検出部を示し、ウインドウ内の最大値、最小値を検出する。７０３はコントラスト算出部を示し、検出された最大値，最小値の差分値を算出する。７０４はｎ’，ｍ’決定部を示し、算出された差分値に応じたｎ’，ｍ’の値を決定する。

【００４８】本例では、差分値が大きくなる程、ｎ’，ｍ’の値を大きくする点が特徴である。図８は、コントラストと、決定するｎ’の関係例を示す。前述したように$1 \leqq n' \leqq N$となる為、コントラストが大きくなるほど、ｎ’は１からＮまで変化するような設定にする。すなわち、エッジが大きくなるほど、解像度変換の重要性が増し、階調性の向上よりも解像性を優先させるものである。

【００４９】また、コントラストの小さい中間調のエッジであれば、解像度変換により高解像のエッジを作成したとしても、その後の擬似中間調処理のために、作成したエッジ情報が完全には反映されなくなる為、本実施の形態のように段階的に解像性、階調性の重みを変化させることは有効である。

＜第３の実施の形態＞図９は、本発明の第３の実施の形態を示すブロック図である。本実施の形態は図４の実施の形態を簡略化したものであり、同一部には同一番号を付してあり、異なる部分のみ説明する。

【００５０】９００は、Ｎ倍×Ｍ倍固定での解像度変換を行う解像度変換部を示す。前述したように、入力情報がＡビット／画素であれば、解像度変換後もＡビット／画素になる。９０１はディザ部を示し、解像度変換後のＡビット／画素の情報をディザ法により２値化する。９０２はＮ倍×Ｍ倍固定の濃度パターン部を示している。

【００５１】９０３はスイッチを示し、評価部９０４からのウインドウの画素値の評価結果としてエッジ部分を含むと判定されればＡ端子を、平坦部分と判定されれば

Ｂ端子を選択する。すなわち、エッジ部分を含めば解像度変換＋ディザ法、平坦部分であれば濃度パターン法を選択する。本実施の形態では、前述の実施の形態のｎ’，ｍ’の値を用いて言い換えると、ｎ’，ｍ’の値を２通りのみとしている点に特徴がある。すなわち、評価部９０４がエッジ部分を含むと判定すれば、ｎ’＝Ｎ、かつ、ｍ’＝Ｍ、また平坦部ならｎ’＝１、ｍ’＝１と決定する。

【００５２】本実施の形態によれば、処理速度が速く、エッジ部分にはジャギーの発生しない良好な画質が実現できる。以上、解像度変換＋擬似中間調処理について説明してきたが、本実施の形態は単色のプリンタにでも、カラーのプリンタにでも適用できることは言うまでもない。カラープリンタの場合には、各色成分毎に本実施の形態を適用して実行すれば良い。

【００５３】次に、図１０を参照して、上述した各実施の形態を実行するハードウエア構成の実施形態を説明する。図１０は、本画像処理装置のハードウエアの概要を示し、ここで、１２００はＣＰＵであり、画像処理装置全体の制御を行う。また、１２０２は、上述した各処理部の処理手順を記述した画像処理プログラム等が格納されているＲＯＭを含み、ＣＰＵ１２００によって読み出され解釈されて実行される。また、メモリ１２０２には、ＲＡＭも含み、前記プログラム実行のための作業領域としてや、画像データや処理結果を格納するために用いられる。また、ラインバッファ１０１は、このＲＡＭ領域の一部に割り当てられている。

【００５４】キーボード１２０３やポインテイングデバイス１２０４は、本画像処理装置に対するコマンドやデータを入力する入力端末である。ディスプレイモニタ１２０１は、入力コマンドや処理結果が表示される。次に、図１１を参照して、メモリ１２０２に格納されている各処理プログラムのレイアウトの一例を説明する。これら各処理プログラムは、ＣＰＵ１２００によって、読み出され、解釈され、実行される。

【００５５】ウインドー作成プログラム１１０１は、図１と図９のウインドウ作成部１０２での元の多値画像からウインドウサイズの画像を切り出す処理を行うプログラムである。解像度変換プログラム１１０２は、図１、図２の解像度変換部１０３と、図４の解像度変換部４０１と、図９の解像度変換部９００での上述した各処理を実行する手順を記述したプログラムである。

【００５６】濃度パターン変換プログラム１１０３は、図１の濃度パターン変換部１０４と図４の濃度パターン変換部４０２と図９の濃度パターン変換部９０２での上述した各処理を実行する手順を記述したプログラムである。評価処理プログラム１１０４は、図４の評価部４００と図７の評価部４０１と図９の評価部９０４での上述した各処理を実行する手順を記述したプログラムである。

【００５７】ディザ処理プログラム１１０５は、図９のディザ部での上述した各処理を実行する手順を記述したプログラムである。ＭＩＮ／ＭＡＸ検出プログラム１１０６は、図７のＭＩＮ、ＭＡＸ検知部での上述した各処理を実行する手順を記述したプログラムである。コントラスト算出プログラム１１０７は、図７のコントラスト算出部での上述した各処理を実行する手順を記述したプログラムである。

【００５８】ｎ’、ｍ’決定プログラム１１０８は、ｎ’、ｍ’決定部での上述した各処理を実行する手順を記述したプログラムである。尚、このレイアウトは、一例であり、その構成順序が異なっても良いことは言うまでもない。尚、本発明は、ホストコンピュータ、インターフェイス、プリンタ等の複数の機器から構成されるシステムに適用しても、複写機等の１つの機器から成る装置に適用しても良い。また、本発明は、システム或は装置に記憶媒体に格納されたプログラムを供給することによって達成される場合にも適用できることは言うまでもない。この場合、本発明に係るプログラムを格納した記録媒体が、本発明を構成することになる。そして、該記録媒体からそのプログラムをシステム或いは装置に読み出すことによって、そのシステム或いは装置が、予め定められたし方で動作する。

【００５９】以上説明したように、本実施の形態によれば、入力した低解像度の多階調画像情報から高解像度の２値画像情報に変換する際に、コスト、及び処理速度での点で負荷が少なく、また、ジャギーがなくエッジのはっきりした画質の良い変換を効率よく処理できる。また、プリンタエンジンの特性、及び視覚特性に合わせた最適化設計が可能になる。

【００６０】

【発明の効果】以上説明したように本発明によれば、低解像度で多階調画像を、ジャギーがなくエッジのはっきりした画質の２値画像に、低コスト、低負荷で、効率よく変換できる。

【図面の簡単な説明】

【図１】本発明の第１の実施の形態を示すブロック図である。

【図２】図１の解像度変換部を示すブロック図である。

【図３】図２の線形補間を示す説明図である。

【図４】本発明の第２の実施の形態を示すブロック図である。

【図５】第２の実施の形態でのエッジ部分の処理例を示す図である。

【図６】第２の実施の形態での平坦部分の処理例を示す図である。

【図７】図２の実施の形態の変形例の評価部を示すブロック図である。

【図８】コントラストと決定するｎ’の関係の一例を示す図である。

【図９】本発明の第３の実施の形態を示すブロック図である。

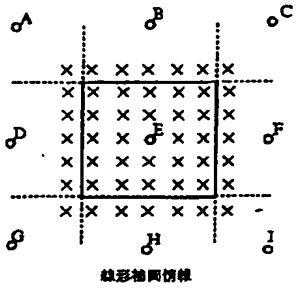
【図１０】本発明の実施の形態の画像処理装置のハードウエア構成を示す図である。

【図１１】メモリ１２０２に格納されている各処理プログラムのレイアウトを示す図である。

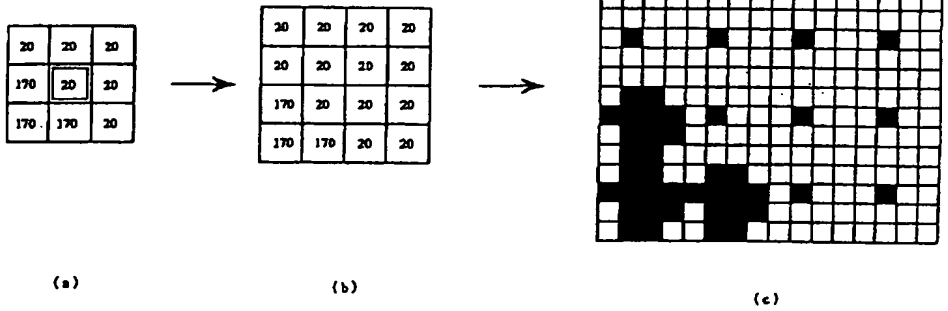
【符号の説明】

１０１　ラインバッファ
１０２　ウインドウ作成部
１０３　解像度変換部
１０４　濃度パターン部

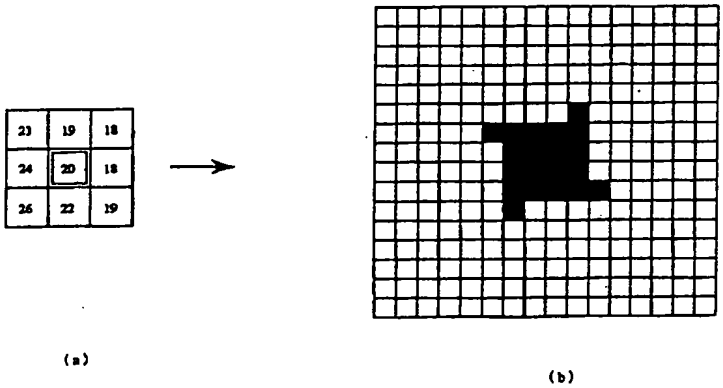
【図３】



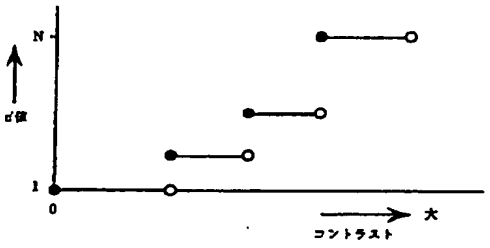
【図５】



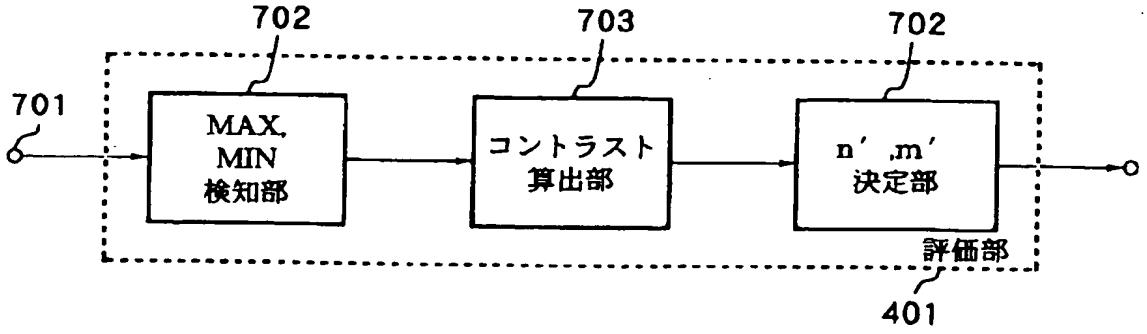
【図６】



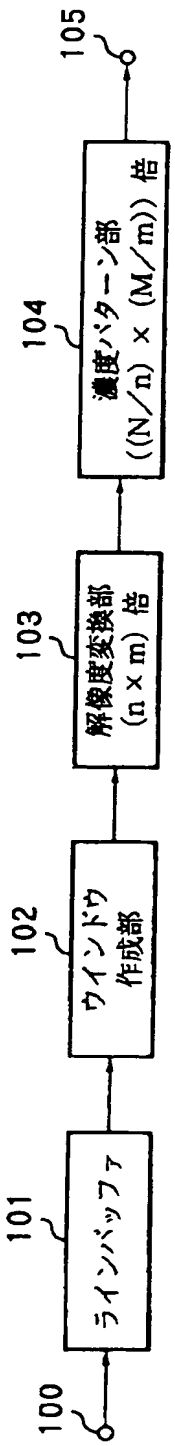
【図８】



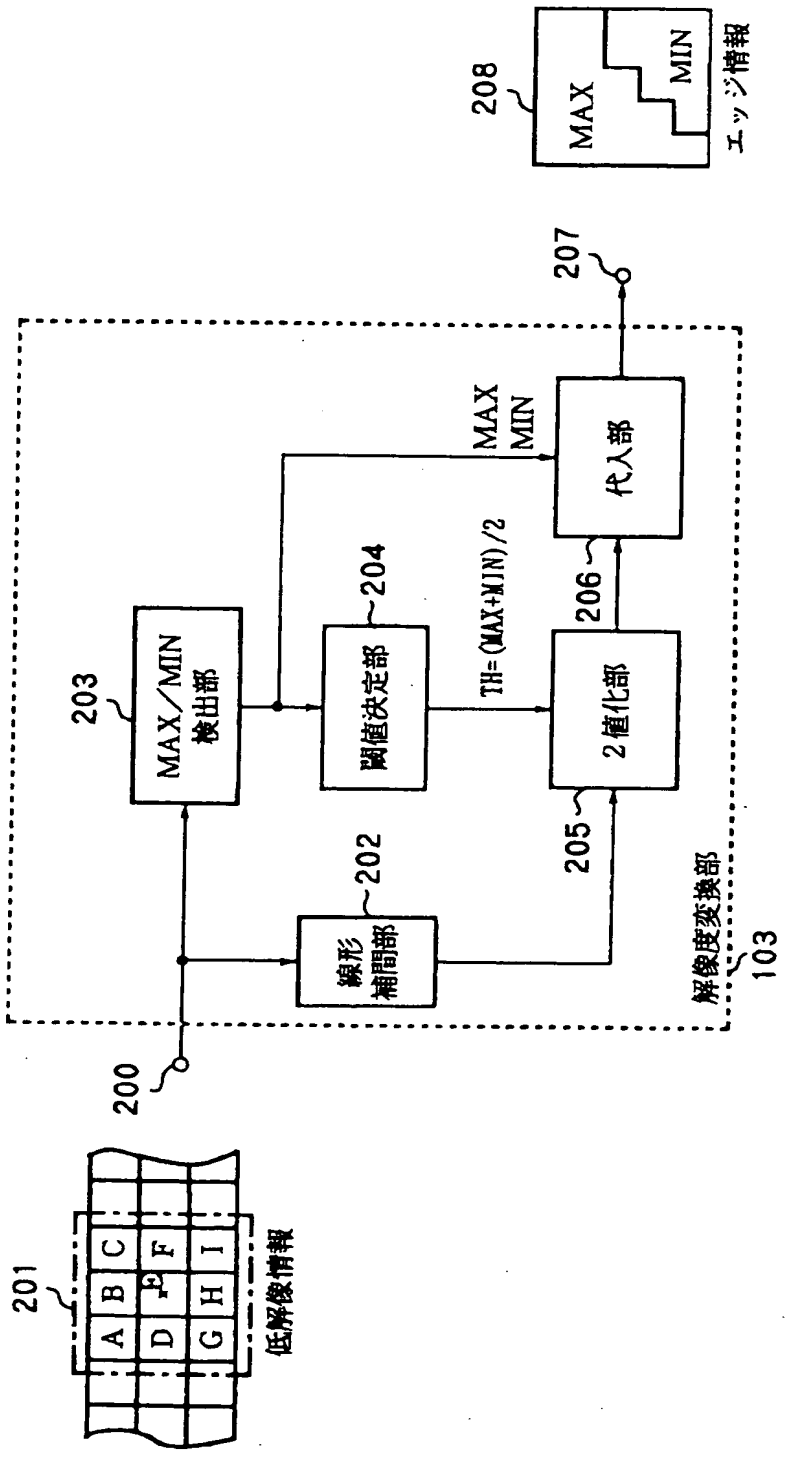
【図７】



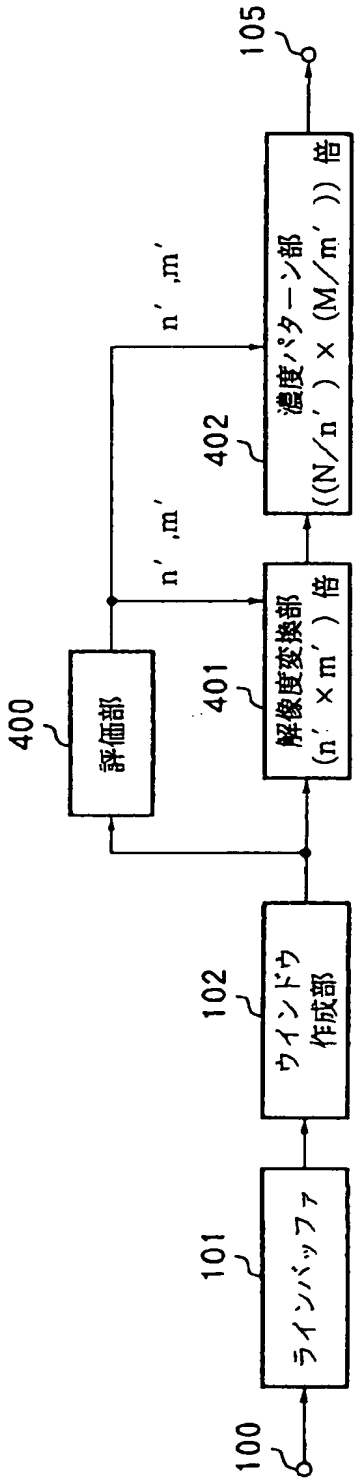
【図1】


100
101
ラインバッファ
102
ウインドウ作成部
103
解像度変換部 (n×m) 倍
104
濃度パターン部 ((N/n)×(M/m)) 倍
105

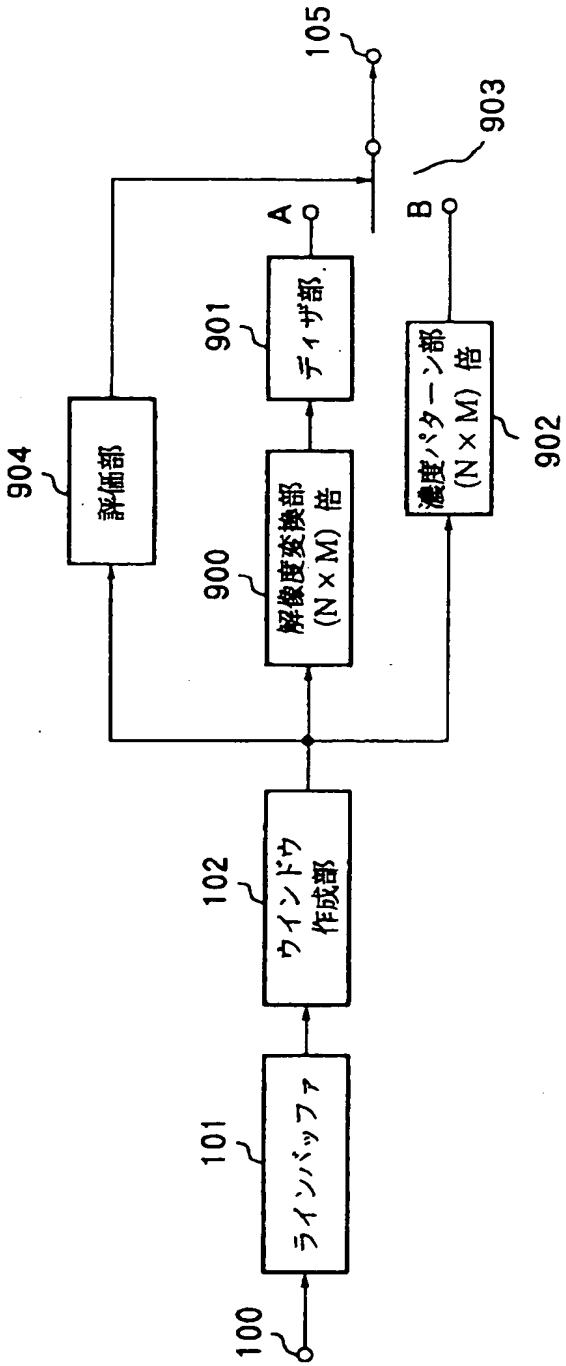
【図2】


208
MAX
MIN
エッジ情報
207
MAX
MIN
代入部
206
TH=(MAX+MIN)/2
204
閾値決定部
203
MAX/MIN 検出部
205
2値化部
202
線形補間部
200
201
A
B
C
D
E
F
G
H
I
低解像情報
解像度変換部
103

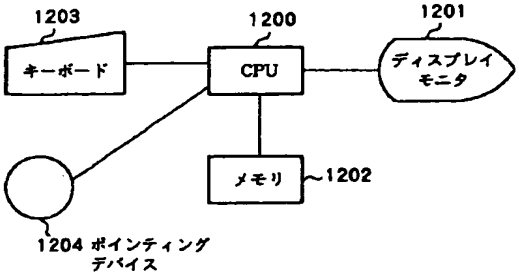
【図4】


100
101
ラインバッファ
102
ウインドウ作成部
400
評価部
401
解像度変換部 (n′×m′) 倍
402
濃度パターン部 ((N/n′)×(M/m′)) 倍
105
n′,m′
n′,m′

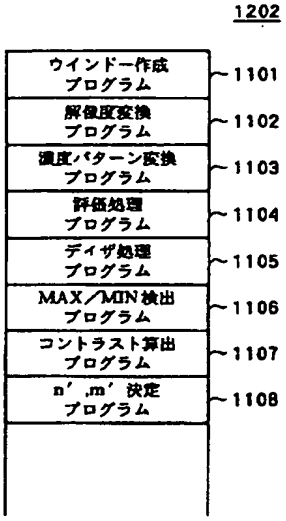
【図9】


100
101
ラインバッファ
102
ウインドウ作成部
900
解像度変換部 (N×M) 倍
901
ディザ部
902
濃度パターン部 (N×M) 倍
903
A
B
904
評価部
105

【図１０】


1203
キーボード
1200
CPU
1201
ディスプレイ
モニタ
メモリ
1202
1204 ポインティング
デバイス

【図１１】


1202
ウインドー作成
プログラム
1101
解像度変換
プログラム
1102
濃度パターン変換
プログラム
1103
評価処理
プログラム
1104
ディザ処理
プログラム
1105
MAX／MIN検出
プログラム
1106
コントラスト算出
プログラム
1107
n′ ,m′ 決定
プログラム
1108

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CLAIMS

[Claim(s)]

[Claim 1] The resolution conversion process which is the image-processing approach of changing N times in a lengthwise direction and changing the 1st multiple-value image into a M times as many binary image as this in a longitudinal direction, increases n times in a lengthwise direction and carries out resolution conversion of said 1st multiple-value image in a longitudinal direction at the 2nd m times as many multiple-value image as this, The image-processing approach characterized by having the concentration pattern conversion process of changing said 2nd multiple-value image into the binary image which expressed N/n times to the lengthwise direction and expressed the concentration of said 2nd multiple-value image in the longitudinal direction in a M/m twice as many combination of two or more pixels as this.

[Claim 2] The maximum / minimum value detection process that said resolution conversion process detects said the 1st maximum concentration value and minimum concentration value of a multiple-value image, The binary-ized threshold generation process which generates the threshold for binary-izing based on said maximum concentration value and minimum concentration value which were detected, The 2nd multiple-value image generation process which interpolates said multiple-value image, generates N times to a lengthwise direction and generates the 2nd M times as many multiple-value image as this in a longitudinal direction, A binary chemically-modified [which makes said 2nd multiple-value image binary based on said threshold, assigns said maximum concentration value and minimum concentration value which were detected, and uses as a binary image said image made binary] degree, The image-processing approach according to claim 1 characterized by having the synthetic process which compounds the binary image generated to the binary chemically-modified [said] degree, and the 2nd multiple-value image generated at said 2nd multiple-value image generation process by the predetermined allocation ratio.

[Claim 3] Said multiple-value image is the image-processing approach according to claim 1 characterized by being the image cut down per window of predetermined size from the predetermined multiple-value image.

[Claim 4] The resolution conversion process which is the image-processing approach of changing N times in a lengthwise direction and changing a multiple-value image into a M times as many binary image as this in a longitudinal direction, increases n times in a

lengthwise direction and carries out resolution conversion of said multiple-value image in a longitudinal direction at the 1st m times as many binary image as this, The image-processing approach characterized by having the concentration pattern conversion process of changing said 1st binary image into the 2nd binary image which expressed N/n times to the lengthwise direction and expressed the concentration of said 1st binary image in the longitudinal direction in a M/m twice as many combination of two or more pixels as this.

[Claim 5] The maximum / minimum value detection process that said resolution conversion process detects the maximum concentration value and the minimum concentration value of said multiple-value image, The binary-ized threshold generation process which generates the threshold for binary-izing based on said maximum concentration value and minimum concentration value which were detected, The 2nd multiple-value image generation process which interpolates said multiple-value image, generates N times to a lengthwise direction and generates the 2nd M times as many multiple-value image as this in a longitudinal direction, The image-processing approach according to claim 4 characterized by having a binary chemically-modified [which makes said 2nd multiple-value image binary with said detected maximum concentration value and the minimum concentration value based on said threshold] degree.

[Claim 6] Said concentration pattern conversion process is the image-processing approach according to claim 1 characterized by changing into the 2nd binary image which is two or more pixels in M/m twice as many combination as this, and expressed the concentration of the pixel of said 1st binary image in N/n times and a longitudinal direction to the lengthwise direction.

[Claim 7] Said multiple-value image is the image-processing approach according to claim 4 characterized by being the image cut down per window of predetermined size from the predetermined multiple-value image.

[Claim 8] The image-processing approach according to claim 7 characterized by having further the repeat execution control process of repeating and performing said resolution conversion process and said concentration pattern conversion process about said whole predetermined multiple-value image.

[Claim 9] The parameter decision process of being the image-processing approach of changing N times in a lengthwise direction and changing a multiple-value image into a M times as many binary image as this in a longitudinal direction, and determining Parameters n and m based on the edge inclination of said multiple-value image, and said N and M, respectively, The resolution conversion process which increases n times in a lengthwise direction and carries out resolution conversion of said multiple-value image in a longitudinal direction at the 1st m times as many binary image as this, The image-processing approach characterized by having the concentration pattern conversion process of changing said 1st binary image into the 2nd binary image which expressed N/n times to the lengthwise direction and expressed the concentration of said 1st binary image in the longitudinal direction in a M/m twice as many combination of two or more pixels as

this.
[Claim 10] Said parameters n and m are the image-processing approaches according to claim 9 which will be characterized by what it opts for relatively to said N and M large, respectively if said edge inclination is large.
[Claim 11] Said parameters n and m are the image-processing approaches according to claim 9 characterized by determining to increase stair-like to the increment direction of said edge inclination.
[Claim 12] The maximum / minimum value detection process that said resolution conversion process detects the maximum concentration value and the minimum concentration value of said multiple-value image, The binary-ized threshold generation process which generates the threshold for binary-izing based on said maximum concentration value and minimum concentration value which were detected, The 2nd multiple-value image generation process which interpolates said multiple-value image, generates N times to a lengthwise direction and generates the 2nd M times as many multiple-value image as this in a longitudinal direction, The image-processing approach according to claim 9 characterized by having a binary chemically-modified [which makes said 2nd multiple-value image binary with said detected maximum concentration value and the minimum concentration value based on said threshold] degree.
[Claim 13] Said concentration pattern conversion process is the image-processing approach according to claim 9 characterized by changing into the 2nd binary image which is two or more pixels in M/m twice as many combination as this, and expressed the concentration of the pixel of said 1st binary image in N/n times and a longitudinal direction to the lengthwise direction.
[Claim 14] Said multiple-value image is the image-processing approach according to claim 9 characterized by being the image cut down per window of predetermined size from the predetermined multiple-value image.
[Claim 15] The image-processing approach according to claim 14 characterized by having further the repeat execution control process of repeating and performing each process of said image-processing approach according to claim 6 about said whole predetermined multiple-value image.
[Claim 16] The parameter decision process of being the image-processing approach of changing N times in a lengthwise direction and changing a multiple-value image into a M times as many binary image as this in a longitudinal direction, and determining Parameters n and m based on the difference C of the maximum of the concentration of said multiple-value image, and the minimum value, and said N and M, respectively, The resolution conversion process which increases n times in a lengthwise direction and carries out resolution conversion of the multiple-value image in a longitudinal direction at the 1st m times as many binary image as this, The image-processing approach characterized by having the concentration pattern conversion process of changing said 1st binary image into the 2nd binary image which expressed N/n times to the lengthwise direction and expressed the concentration of said 1st binary image in the longitudinal direction in a M/m twice as

many combination of two or more pixels as this.
[Claim 17] Said parameters n and m are the image-processing approaches according to claim 16 which will be characterized by what it opts for relatively to said N and M large, respectively if said difference C is large.
[Claim 18] Said parameters n and m are the image-processing approaches according to claim 16 characterized by determining to increase stair-like to the increment direction of said difference C.
[Claim 19] The maximum / minimum value detection process that said resolution conversion process detects the maximum concentration value and the minimum concentration value of said multiple-value image, The binary-ized threshold generation process which generates the threshold for binary-izing based on said maximum concentration value and minimum concentration value which were detected, The 2nd multiple-value image generation process which interpolates said multiple-value image, generates N times to a lengthwise direction and generates the 2nd M times as many multiple-value image as this in a longitudinal direction, The image-processing approach according to claim 16 characterized by having a binary chemically-modified [which makes said 2nd multiple-value image binary with said detected maximum concentration value and the minimum concentration value based on said threshold] degree.
[Claim 20] Said concentration pattern conversion process is the image-processing approach according to claim 16 characterized by changing into the 2nd binary image which is two or more pixels in M/m twice as many combination as this, and expressed the concentration of the pixel of said 1st binary image in N/n times and a longitudinal direction to the lengthwise direction.
[Claim 21] Said multiple-value image is the image-processing approach according to claim 16 characterized by being the image cut down per window of predetermined size from the predetermined multiple-value image.
[Claim 22] The image-processing approach according to claim 16 characterized by having further the repeat execution control process of repeating and performing each process of said image-processing approach according to claim 13 about said whole predetermined multiple-value image.
[Claim 23] The resolution conversion process which is the image-processing approach of changing N times in a lengthwise direction and changing a multiple-value image into a M times as many binary image as this in a longitudinal direction, increases N times in a lengthwise direction and carries out resolution conversion of said multiple-value image in a longitudinal direction at the 1st M times as many binary image as this, The dither conversion process of changing said 1st binary image into the 2nd binary image with a dither method, If the concentration pattern conversion process of changing said multiple-value image into the 3rd binary image which expressed N times to the lengthwise direction and expressed the concentration of said multiple-value image by one M times the combination of two or more pixels of this in the longitudinal direction, and said multiple-value image contain the edge beyond predetermined inclination The

image-processing approach characterized by having the selection process which chooses said 3rd binary image if said 2nd binary image is chosen and said multiple-value image does not contain the edge beyond predetermined inclination.
[Claim 24] The maximum / minimum value detection process that said resolution conversion process detects the maximum concentration value and the minimum concentration value of said multiple-value image, The binary-ized threshold generation process which generates the threshold for binary-izing based on said maximum concentration value and minimum concentration value which were detected, The 2nd multiple-value image generation process which interpolates said multiple-value image, generates N times to a lengthwise direction and generates the 2nd M times as many multiple-value image as this in a longitudinal direction, The image-processing approach according to claim 23 characterized by having a binary chemically-modified [which makes said 2nd multiple-value image binary with said detected maximum concentration value and the minimum concentration value based on said threshold] degree.
[Claim 25] Said multiple-value image is the image-processing approach according to claim 20 characterized by being the image cut down per window of predetermined size from the predetermined multiple-value image.
[Claim 26] The image-processing approach according to claim 25 characterized by having further the repeat execution control process of repeating and performing each process of the image-processing approach according to claim 25 about said whole predetermined multiple-value image.
[Claim 27] Said edge is the image-processing approach given in any of claim 9 characterized by being obtained by making a predetermined edge detection filter act on said multiple-value image, or claim 23 they are.
[Claim 28] The resolution conversion means which is the image processing system which changes N times in a lengthwise direction and changes a multiple-value image into a M times as many binary image as this in a longitudinal direction, increases n times in a lengthwise direction and carries out resolution conversion of said multiple-value image in a longitudinal direction at the 1st m times as many binary image as this, The image processing system characterized by having a concentration pattern conversion means to change said 1st binary image into the 2nd binary image which expressed N/n times to the lengthwise direction and expressed the concentration of said 1st binary image in the longitudinal direction in a M/m twice as many combination of two or more pixels as this.
[Claim 29] The maximum / a minimum value detection means by which said resolution conversion means detects the maximum concentration value and the minimum concentration value of said multiple-value image, A binary-ized threshold generation means to generate the threshold for binary-izing based on said maximum concentration value and minimum concentration value which were detected, The 2nd multiple-value image generation means which interpolates said multiple-value image, generates N times to a lengthwise direction and generates the 2nd M times as many multiple-value image as this in a longitudinal direction, The image processing system according to claim 28

characterized by having a binary-ized means to make said 2nd multiple-value image binary with said detected maximum concentration value and the minimum concentration value based on said threshold.

[Claim 30] Said concentration pattern conversion means is an image processing system according to claim 28 characterized by changing into the 2nd binary image which is two or more pixels in M/m twice as many combination as this, and expressed the concentration of the pixel of said 1st binary image in N/n times and a longitudinal direction to the lengthwise direction.

[Claim 31] Said multiple-value image is an image processing system according to claim 28 characterized by being the image cut down per window of predetermined size from the predetermined multiple-value image.

[Claim 32] The image processing system according to claim 31 characterized by having further a repeat execution control means to repeat and perform said resolution conversion means and said concentration pattern conversion means about said whole predetermined multiple-value image.

[Claim 33] A parameter decision means to be the image processing system which changes N times in a lengthwise direction and changes a multiple-value image into a M times as many binary image as this in a longitudinal direction, and to determine Parameters n and m based on the edge inclination of said multiple-value image, and said N and M, respectively, The resolution conversion means which increases n times in a lengthwise direction and carries out resolution conversion of said multiple-value image in a longitudinal direction at the 1st m times as many binary image as this, The image processing system characterized by having a concentration pattern conversion means to change said 1st binary image into the 2nd binary image which expressed N/n times to the lengthwise direction and expressed the concentration of said 1st binary image in the longitudinal direction in a M/m twice as many combination of two or more pixels as this.

[Claim 34] Said parameters n and m are image processing systems according to claim 33 which will be characterized by what it opts for relatively to said N and M large, respectively if said edge inclination is large.

[Claim 35] Said parameters n and m are image processing systems according to claim 33 characterized by determining to increase stair-like to the increment direction of said edge inclination.

[Claim 36] The maximum / a minimum value detection means by which said resolution conversion means detects the maximum concentration value and the minimum concentration value of said multiple-value image, A binary-ized threshold generation means to generate the threshold for binary-izing based on said maximum concentration value and minimum concentration value which were detected, The 2nd multiple-value image generation means which interpolates said multiple-value image, generates N times to a lengthwise direction and generates the 2nd M times as many multiple-value image as this in a longitudinal direction, The image processing system according to claim 33 characterized by having a binary-ized means to make said 2nd multiple-value image

binary with said detected maximum concentration value and the minimum concentration value based on said threshold.

[Claim 37] Said concentration pattern conversion means is an image processing system according to claim 33 characterized by changing into the 2nd binary image which is two or more pixels in M/m twice as many combination as this, and expressed the concentration of the pixel of said 1st binary image in N/n times and a longitudinal direction to the lengthwise direction.

[Claim 38] Said multiple-value image is an image processing system according to claim 33 characterized by being the image cut down per window of predetermined size from the predetermined multiple-value image.

[Claim 39] The image processing system according to claim 38 characterized by having further a repeat execution control means to repeat and perform each means of said image processing system according to claim 30 about said whole predetermined multiple-value image.

[Claim 40] A parameter decision means to be the image processing system which changes N times in a lengthwise direction and changes a multiple-value image into a M times as many binary image as this in a longitudinal direction, and to determine Parameters n and m based on the difference C of the maximum of the concentration of said multiple-value image, and the minimum value, and said N and M, respectively, The resolution conversion means which increases n times in a lengthwise direction and carries out resolution conversion of the multiple-value image in a longitudinal direction at the 1st m times as many binary image as this, The image processing system characterized by having a concentration pattern conversion means to change said 1st binary image into the 2nd binary image which expressed N/n times to the lengthwise direction and expressed the concentration of said 1st binary image in the longitudinal direction in a M/m twice as many combination of two or more pixels as this.

[Claim 41] Said parameters n and m are image processing systems according to claim 40 which will be characterized by what it opts for relatively to said N and M large, respectively if said difference C is large.

[Claim 42] Said parameters n and m are image processing systems according to claim 40 characterized by determining to increase stair-like to the increment direction of said difference C.

[Claim 43] The maximum / a minimum value detection means by which said resolution conversion means detects the maximum concentration value and the minimum concentration value of said multiple-value image, A binary-ized threshold generation means to generate the threshold for binary-izing based on said maximum concentration value and minimum concentration value which were detected, The 2nd multiple-value image generation means which interpolates said multiple-value image, generates N times to a lengthwise direction and generates the 2nd M times as many multiple-value image as this in a longitudinal direction, The image processing system according to claim 40 characterized by having a binary-ized means to make said 2nd multiple-value image

binary with said detected maximum concentration value and the minimum concentration value based on said threshold.

[Claim 44] Said concentration pattern conversion means is an image processing system according to claim 40 characterized by changing into the 2nd binary image which is two or more pixels in M/m twice as many combination as this, and expressed the concentration of the pixel of said 1st binary image in N/n times and a longitudinal direction to the lengthwise direction.

[Claim 45] Said multiple-value image is an image processing system according to claim 40 characterized by being the image cut down per window of predetermined size from the predetermined multiple-value image.

[Claim 46] The image processing system according to claim 40 characterized by having further a repeat execution control means to repeat and perform each means of said image processing system according to claim 13 about said whole predetermined multiple-value image.

[Claim 47] The resolution conversion means which is the image processing system which changes N times in a lengthwise direction and changes a multiple-value image into a M times as many binary image as this in a longitudinal direction, increases N times in a lengthwise direction and carries out resolution conversion of said multiple-value image in a longitudinal direction at the 1st M times as many binary image as this, A dither conversion means to change said 1st binary image into the 2nd binary image with a dither method, If a concentration pattern conversion means to change said multiple-value image into the 3rd binary image which expressed N times to the lengthwise direction and expressed the concentration of said multiple-value image by one M times the combination of two or more pixels of this in the longitudinal direction, and said multiple-value image contain the edge beyond predetermined inclination The image processing system characterized by having a selection means to choose said 3rd binary image if said 2nd binary image is chosen and said multiple-value image does not contain the edge beyond predetermined inclination.

[Claim 48] The maximum / a minimum value detection means by which said resolution conversion means detects the maximum concentration value and the minimum concentration value of said multiple-value image, A binary-ized threshold generation means to generate the threshold for binary-izing based on said maximum concentration value and minimum concentration value which were detected, The 2nd multiple-value image generation means which interpolates said multiple-value image, generates N times to a lengthwise direction and generates the 2nd M times as many multiple-value image as this in a longitudinal direction, The image processing system according to claim 47 characterized by having a binary-ized means to make said 2nd multiple-value image binary with said detected maximum concentration value and the minimum concentration value based on said threshold.

[Claim 49] Said multiple-value image is an image processing system according to claim 47 characterized by being the image cut down per window of predetermined size from the

predetermined multiple-value image.
[Claim 50] The image processing system according to claim 49 characterized by having further a repeat execution control means to repeat and perform each means of an image processing system according to claim 49 about said whole predetermined multiple-value image.
[Claim 51] Said edge is an image processing system given in any of claim 33 characterized by being obtained by making a predetermined edge detection filter act on said multiple-value image, or claim 47 they are.
[Claim 52] It is a computer program product and sets to an image processing system. A multiple-value image to a lengthwise direction N times, A longitudinal direction is equipped with the medium which has a program code means in which computer reading is possible to change into a M times as many binary image as this. Said computer program product The program code means which increases n times in a lengthwise direction and carries out resolution conversion of said multiple-value image in a longitudinal direction at the 1st m times as many binary image as this and in which computer reading is possible, It is characterized by having a program code means in which computer reading is possible to change said 1st binary image into the 2nd binary image which expressed N/n times to the lengthwise direction and expressed the concentration of said 1st binary image in the longitudinal direction in a M/m twice as many combination of two or more pixels as this.
[Claim 53] It is a computer program product and sets to an image processing system. A multiple-value image to a lengthwise direction N times, A longitudinal direction is equipped with the medium which has a program code means in which computer reading is possible to change into a M times as many binary image as this. Said computer program product A program code means in which computer reading is possible to determine Parameters n and m based on the edge inclination of said multiple-value image, and said N and M, respectively, The program code means which increases n times in a lengthwise direction and carries out resolution conversion of said multiple-value image in a longitudinal direction at the 1st m times as many binary image as this and in which computer reading is possible, It is characterized by having a program code means in which computer reading is possible to change said 1st binary image into the 2nd binary image which expressed N/n times to the lengthwise direction and expressed the concentration of said 1st binary image in the longitudinal direction in a M/m twice as many combination of two or more pixels as this.
[Claim 54] It is a computer program product and sets to an image processing system. A multiple-value image to a lengthwise direction N times, A longitudinal direction is equipped with the medium which has a program code means in which computer reading is possible to change into a M times as many binary image as this. Said computer program product A program code means in which computer reading is possible to determine Parameters n and m based on the difference C of the maximum of the concentration of said multiple-value image, and the minimum value, and said N and M, respectively, The program code means which increases n times in a lengthwise direction and carries out

resolution conversion of the multiple-value image in a longitudinal direction at the 1st m times as many binary image as this and in which computer reading is possible, It is characterized by having a program code means in which computer reading is possible to change said 1st binary image into the 2nd binary image which expressed N/n times to the lengthwise direction and expressed the concentration of said 1st binary image in the longitudinal direction in a M/m twice as many combination of two or more pixels as this.
[Claim 55] It is a computer program product and sets to an image processing system. A multiple-value image to a lengthwise direction N times, A longitudinal direction is equipped with the medium which has a program code means in which computer reading is possible to change into a M times as many binary image as this. Said computer program product The program code means which increases N times in a lengthwise direction and carries out resolution conversion of said multiple-value image in a longitudinal direction at the 1st M times as many binary image as this and in which computer reading is possible, and said 1st binary image with a dither method A program code means in which computer reading is possible to change into the 2nd binary image, A program code means in which computer reading is possible to change said multiple-value image into the 3rd binary image which expressed N times to the lengthwise direction and expressed the concentration of said multiple-value image by one M times the combination of two or more pixels of this in the longitudinal direction, If said multiple-value image contains the edge beyond predetermined inclination, said 2nd binary image is chosen and said multiple-value image does not contain the edge beyond predetermined inclination, it is characterized by having a program code means in which computer reading is possible to choose said 3rd binary image.
[Claim 56] The resolution conversion means which is the image processing system which changes N times in a lengthwise direction and changes the 1st multiple-value image into a M times as many binary image as this in a longitudinal direction, increases n times in a lengthwise direction and carries out resolution conversion of said 1st multiple-value image in a longitudinal direction at the 2nd m times as many multiple-value image as this, The image processing system characterized by having a concentration pattern conversion means to change said 2nd multiple-value image into the binary image which expressed N/n times to the lengthwise direction and expressed the concentration of said 2nd multiple-value image in the longitudinal direction in a M/m twice as many combination of two or more pixels as this.
[Claim 57] The maximum / a minimum value detection means by which said resolution conversion means detects said the 1st maximum concentration value and minimum concentration value of a multiple-value image, A binary-ized threshold generation means to generate the threshold for binary-izing based on said maximum concentration value and minimum concentration value which were detected, The 2nd multiple-value image generation means which interpolates said multiple-value image, generates N times to a lengthwise direction and generates the 2nd M times as many multiple-value image as this in a longitudinal direction, The binary-ized means which makes said 2nd multiple-value

image binary based on said threshold, assigns said maximum concentration value and minimum concentration value which were detected, and uses as a binary image said image made binary, The image processing system according to claim 56 characterized by having a synthetic means to compound the binary image generated with said binary-ized means, and the 2nd multiple-value image generated with said 2nd multiple-value image generation means by the predetermined allocation ratio.

[Claim 58] Said multiple-value image is an image processing system according to claim 56 characterized by being the image cut down per window of predetermined size from the predetermined multiple-value image.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the image-processing approach, the equipment and the art which makes image information of many gradation binary with a low resolution especially, and its equipment.

[0002]

[Description of the Prior Art] Various approaches are proposed as an approach of conventionally changing into the binary information on high resolving information the multi-gradation information on low resolving that it inputted. The approach of expressing gradation in a predetermined field with the number of the pixels set to "1" at the time of making binary 1-pixel gradation information that it is called a concentration pattern method and inputted is the most common.

[0003] By this approach, since the number of pixels increases, image size becomes large and different output resolution from input resolution can be realized. However, by this approach, actual definition does not necessarily improve only by using two or more pixels in order to raise 1-pixel gradation nature. Then, this concentration pattern method was improved and the proposal which is going to raise definition has been made more in ancient times.

[0004] Among those, as main approaches, there are an approach used with the dither method and the approach of changing the conversion pattern to a concentration pattern accommodative similarly. For example, by the flat part, using the so-called concentration type in which the pixel used as "1" is buried from the center of pattern, in the edge section, in order to raise definition, there is the approach using the so-called distributed process input output equipment pattern of scattering the pixel used as "1" and arranging etc.

[0005] Moreover, there are an approach of creating the edge which is made to arrange well the pixel set to "1" from the information on a contiguity pixel, and does not have a smooth jaggy, and the approach of setting up using LUT so that the condition of a contiguity pixel to a slash etc. may become smooth as proposed USP4742399 as it is proposed by USP4355337 in expansion in the edge section, and binary-ized processing, although it

differs from a concentration pattern method.

[0006] Moreover, after carrying out resolution conversion by a certain approach by the approach of not using a concentration pattern, with the information on many gradation, the method of performing false halftone processings of twice, such as not being accompanied by expansion processing of a dither method, an error diffusion method, etc., is common.

[0007]

[Problem(s) to be Solved by the Invention] However, there was a fault shown below in the above-mentioned conventional example. First, the purpose in the ecad of the pattern in a concentration pattern method is a thing to save loss of the information produced when the submatrix in the time of the false halftone processing by the concentration pattern is used, and its definition does not improve at all from the information from the first on low resolving.

[0008] For example, even if a slash is in the inputted image of a low resolution, by this approach, creation of a slash without a jaggy cannot be desired with high resolution. Although gradation nature and definition become rebellion conditions when a submatrix is used, this is changed accommodative. Moreover, although it is the approach of arranging well the pixel set to "1" based on the value in the low resolution mentioned above using an operation or LUT, it will become the image with which all the smooth edges that a natural image has were trimmed with the halftone of a natural image etc., for example since the pixel of "1" would solidify, if such processing was carried out.

[0009] Moreover, although image readers, such as an image scanner, and the information which the MTF property (Modulation transfer function) required to the edge through FAX etc. are taken into consideration in the above-mentioned conventional example, when used by a printer etc., information will be soon transmitted from a host computer, for example. If it becomes blunt on an edge by the alphabetic character and line drawing image which were artificially created by computer and the attention pixel value in a low resolution itself is not changed for so-called knife edge without **, the resolution conversion to high resolving which a jaggy does not produce is difficult.

[0010] Moreover, although it is satisfactory in image quality, since image size increases also dozens times from several times after making it high resolving, it starts and is not very efficient [carrying out false halftone processing, after resolution changing in the condition of many gradation itself / a load] cost-wise and in processing speed. For example, a binary color printer is assumed per color in which an output is possible at 1200dpix1200dpi. When this printer tends to output the image of A4 size and 8 bits [per color] image information is inputted by 1200dpix1200dpi, the amount of information of hundreds of M bytes is not needed and realistic. Then, the image information of a low resolution is inputted and the configuration output by carrying out resolution conversion and binary-ized processing is taken.

[0011] The input of 8 bits [per color] image information is considered for example, by 75dpix75dpi here. In this case, the amount of input can be managed with the amount of

information of x (1/16) (1/16) of a 1200dpix1200dpi input, and is realistic. Although outputted with the value which doubled the resolution conversion of this input image (16x16), and carried out binary-ized processing, if false halftone processing is performed after carrying out resolution conversion altogether like the gestalt of operation mentioned above, without reducing the number of gradation, a lot of information must be treated after all, and a place load will become very heavy.

[0012] This invention was made in view of the above-mentioned conventional example, and aims at offering the image-processing approach which is low cost and a low load and can be efficiently changed into the binary image of image quality with which there is no jaggy about a multi-gradation image at a low resolution, and the edge clarified, and its equipment.

[0013]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the computer program product equips the image-processing approach and equipment of this invention, and a list with the following configurations. Namely, the resolution conversion process which is the image-processing approach of changing N times in a lengthwise direction and changing the 1st multiple-value image into a M times as many binary image as this in a longitudinal direction, increases n times in a lengthwise direction and carries out resolution conversion of said 1st multiple-value image in a longitudinal direction at the 2nd m times as many multiple-value image as this, It has the concentration pattern conversion process of changing said 2nd multiple-value image into the binary image which expressed N/n times to the lengthwise direction and expressed the concentration of said 2nd multiple-value image in the longitudinal direction in a M/m twice as many combination of two or more pixels as this.

[0014] Moreover, the resolution conversion process which another invention is the image-processing approach that change N times in a lengthwise direction and it changes a multiple-value image into a M times as many binary image as this in a longitudinal direction, and increases n times in a lengthwise direction and carries out resolution conversion of said multiple-value image in a longitudinal direction at the 1st m times as many binary image as this, It has the concentration pattern conversion process of changing said 1st binary image into the 2nd binary image which expressed N/n times to the lengthwise direction and expressed the concentration of said 1st binary image in the longitudinal direction in a M/m twice as many combination of two or more pixels as this.

[0015] Moreover, the parameter decision process of another invention being the image-processing approach that change N times in a lengthwise direction and it changes a multiple-value image into a M times as many binary image as this in a longitudinal direction, and determining Parameters n and m based on the edge inclination of said multiple-value image, and said N and M, respectively, The resolution conversion process which increases n times in a lengthwise direction and carries out resolution conversion of said multiple-value image in a longitudinal direction at the 1st m times as many binary image as this, It has the concentration pattern conversion process of changing said 1st

binary image into the 2nd binary image which expressed N/n times to the lengthwise direction and expressed the concentration of said 1st binary image in the longitudinal direction in a M/m twice as many combination of two or more pixels as this.

[0016] Moreover, another invention is the image-processing approach that change N times in a lengthwise direction and it changes a multiple-value image into a M times as many binary image as this in a longitudinal direction. The parameter decision process of determining Parameters n and m based on the difference C of the maximum of the concentration of said multiple-value image, and the minimum value, and said N and M, respectively, The resolution conversion process which increases n times in a lengthwise direction and carries out resolution conversion of the multiple-value image in a longitudinal direction at the 1st m times as many binary image as this, It has the concentration pattern conversion process of changing said 1st binary image into the 2nd binary image which expressed N/n times to the lengthwise direction and expressed the concentration of said 1st binary image in the longitudinal direction in a M/m twice as many combination of two or more pixels as this.

[0017] Moreover, the resolution conversion process which another invention is the image-processing approach that change N times in a lengthwise direction and it changes a multiple-value image into a M times as many binary image as this in a longitudinal direction, and increases N times in a lengthwise direction and carries out resolution conversion of said multiple-value image in a longitudinal direction at the 1st M times as many binary image as this, The dither conversion process of changing said 1st binary image into the 2nd binary image with a dither method, If the concentration pattern conversion process of changing said multiple-value image into the 3rd binary image which expressed N times to the lengthwise direction and expressed the concentration of said multiple-value image by one M times the combination of two or more pixels of this in the longitudinal direction, and said multiple-value image contain the edge beyond predetermined inclination If said 2nd binary image is chosen and said multiple-value image does not contain the edge beyond predetermined inclination, it has the selection process which chooses said 3rd binary image.

[0018] Moreover, the resolution conversion means which another invention is an image processing system from which it changes N times in a lengthwise direction, and it changes a multiple-value image into a M times as many binary image as this in a longitudinal direction, and increases n times in a lengthwise direction and carries out resolution conversion of said multiple-value image in a longitudinal direction at the 1st m times as many binary image as this, It has a concentration pattern conversion means to change said 1st binary image into the 2nd binary image which expressed N/n times to the lengthwise direction and expressed the concentration of said 1st binary image in the longitudinal direction in a M/m twice as many combination of two or more pixels as this.

[0019] Moreover, a parameter decision means for another invention to be an image processing system from which it changes N times in a lengthwise direction, and it changes a multiple-value image into a M times as many binary image as this in a longitudinal

direction, and to determine Parameters n and m based on the edge inclination of said multiple-value image, and said N and M, respectively, The resolution conversion means which increases n times in a lengthwise direction and carries out resolution conversion of said multiple-value image in a longitudinal direction at the 1st m times as many binary image as this, It has a concentration pattern conversion means to change said 1st binary image into the 2nd binary image which expressed N/n times to the lengthwise direction and expressed the concentration of said 1st binary image in the longitudinal direction in a M/m twice as many combination of two or more pixels as this.

[0020] Moreover, another invention is an image processing system from which it changes N times in a lengthwise direction, and it changes a multiple-value image into a M times as many binary image as this in a longitudinal direction. A parameter decision means to determine Parameters n and m based on the difference C of the maximum of the concentration of said multiple-value image, and the minimum value, and said N and M, respectively, The resolution conversion means which increases n times in a lengthwise direction and carries out resolution conversion of the multiple-value image in a longitudinal direction at the 1st m times as many binary image as this, It has a concentration pattern conversion means to change said 1st binary image into the 2nd binary image which expressed N/n times to the lengthwise direction and expressed the concentration of said 1st binary image in the longitudinal direction in a M/m twice as many combination of two or more pixels as this.

[0021] Moreover, the resolution conversion means which another invention is an image processing system from which it changes N times in a lengthwise direction, and it changes a multiple-value image into a M times as many binary image as this in a longitudinal direction, and increases N times in a lengthwise direction and carries out resolution conversion of said multiple-value image in a longitudinal direction at the 1st M times as many binary image as this, A dither conversion means to change said 1st binary image into the 2nd binary image with a dither method, If a concentration pattern conversion means to change said multiple-value image into the 3rd binary image which expressed N times to the lengthwise direction and expressed the concentration of said multiple-value image by one M times the combination of two or more pixels of this in the longitudinal direction, and said multiple-value image contain the edge beyond predetermined inclination If said 2nd binary image is chosen and said multiple-value image does not contain the edge beyond predetermined inclination, it has a selection means to choose said 3rd binary image.

[0022] Moreover, another invention is a computer program product and is set to an image processing system. It has the medium which changes N times in a lengthwise direction and changes a multiple-value image into a M times as many binary image as this in a longitudinal direction and which has the program code means in which computer reading is possible. Said computer program product The program code means which increases n times in a lengthwise direction and carries out resolution conversion of said multiple-value image in a longitudinal direction at the 1st m times as many binary image as this and in which computer reading is possible, It has a program code means in which computer

reading is possible to change said 1st binary image into the 2nd binary image which expressed N/n times to the lengthwise direction and expressed the concentration of said 1st binary image in the longitudinal direction in a M/m twice as many combination of two or more pixels as this.

[0023] Moreover, another invention is a computer program product and is set to an image processing system. It has the medium which changes N times in a lengthwise direction and changes a multiple-value image into a M times as many binary image as this in a longitudinal direction and which has the program code means in which computer reading is possible. Said computer program product A program code means in which computer reading is possible to determine Parameters n and m based on the edge inclination of said multiple-value image, and said N and M, respectively, The program code means which increases n times in a lengthwise direction and carries out resolution conversion of said multiple-value image in a longitudinal direction at the 1st m times as many binary image as this and in which computer reading is possible, It has a program code means in which computer reading is possible to change said 1st binary image into the 2nd binary image which expressed N/n times to the lengthwise direction and expressed the concentration of said 1st binary image in the longitudinal direction in a M/m twice as many combination of two or more pixels as this.

[0024] Moreover, another invention is a computer program product and is set to an image processing system. It has the medium which changes N times in a lengthwise direction and changes a multiple-value image into a M times as many binary image as this in a longitudinal direction and which has the program code means in which computer reading is possible. Said computer program product A program code means in which computer reading is possible to determine Parameters n and m based on the difference C of the maximum of the concentration of said multiple-value image, and the minimum value, and said N and M, respectively, The program code means which increases n times in a lengthwise direction and carries out resolution conversion of the multiple-value image in a longitudinal direction at the 1st m times as many binary image as this and in which computer reading is possible, It has a program code means in which computer reading is possible to change said 1st binary image into the 2nd binary image which expressed N/n times to the lengthwise direction and expressed the concentration of said 1st binary image in the longitudinal direction in a M/m twice as many combination of two or more pixels as this.

[0025] Moreover, another invention is a computer program product and is set to an image processing system. It has the medium which changes N times in a lengthwise direction and changes a multiple-value image into a M times as many binary image as this in a longitudinal direction and which has the program code means in which computer reading is possible. Said computer program product The program code means which increases N times in a lengthwise direction and carries out resolution conversion of said multiple-value image in a longitudinal direction at the 1st M times as many binary image as this and in which computer reading is possible, and said 1st binary image with a dither method A

program code means in which computer reading is possible to change into the 2nd binary image, A program code means in which computer reading is possible to change said multiple-value image into the 3rd binary image which expressed N times to the lengthwise direction and expressed the concentration of said multiple-value image by one M times the combination of two or more pixels of this in the longitudinal direction, If said multiple-value image contains the edge beyond predetermined inclination, said 2nd binary image is chosen and said multiple-value image does not contain the edge beyond predetermined inclination, it has a program code means in which computer reading is possible to choose said 3rd binary image.

[0026] Moreover, the resolution conversion means which another invention is an image processing system from which it changes N times in a lengthwise direction, and it changes the 1st multiple-value image into a M times as many binary image as this in a longitudinal direction, and increases n times in a lengthwise direction and carries out resolution conversion of said 1st multiple-value image in a longitudinal direction at the 2nd m times as many multiple-value image as this, It has a concentration pattern conversion means to change said 2nd multiple-value image into the binary image which expressed N/n times to the lengthwise direction and expressed the concentration of said 2nd multiple-value image in the longitudinal direction in a M/m twice as many combination of two or more pixels as this.

[0027]

[Embodiment of the Invention]

<Gestalt of the 1st operation> drawing 1 is a block diagram showing the gestalt of the 1st operation concerning this invention. Although it is efficient to provide mainly inside image output units, such as a printer, as for the image processing system of the gestalt of operation concerning this invention, it is also possible to build as image processing systems other than an image output unit, the application software in a host computer, or printer driver software.

[0028] The operations sequence of the gestalt of this operation is explained along with the block diagram of drawing 1 . The gestalt of this operation describes the inputted example which changes the image information of a multiple value into image information binary [M times the width / N times as many length as this and / of this] per pixel. Among drawing 1 , 100 show an input terminal and the image information of low resolving is inputted. This low resolving information is stored and held by the line buffer 101 by several lines. Based on this image information for several lines, 102 is the windowing section and creates the window which is the reference pixel of the pixel (XxY) unit centering on an attention pixel. 103 is a resolution transducer and extends 1 pixel of attentions to two or more pixels using the pixel value in a window.

[0029] Here, if the dilation ratio in the resolution transducer 103 is made into n times as many length as this and m times as many width as this, 1 pixel of attentions will be changed into a pixel (nxm). If an attention pixel assumes this conversion to be the information which has the number of gradation which is A bits, the number of gradation

will change into the information for a pixel (nxm) with A bits. Moreover, n and m are 1 for an integer of N and M, respectively, and are taken as n!=N and m!=M.

[0030] 104 is the concentration pattern section and is a means to create 1 pixel to two or more pixels [of the multiple value after resolution conversion] binary information. In addition, since this concentration pattern method is well-known, detail explanation is omitted. Input is the resolution transducer 103, and since it has doubled (nxm), the binary information created by the concentration pattern method already becomes enough [vertical (N/n) twice and width (M/m) twice].

[0031] It is transmitted to an output terminal 105 by the resolution transducer 103 and the concentration pattern section 104, and the image information doubled NxM as a result is outputted with the printer engine of a binary output etc. In the above configuration, one description of this invention is in the point of having a concentration pattern method for resolution conversion and binary-izing.

[0032] A concentration pattern method expresses gradation in a field by having the two or more pixels pixel which is binary. That is, definition is raised in the resolution transducer 103 and gradation nature is expressed in the concentration pattern section 104. An example of the processing configuration of the resolution transducer 103 is shown in drawing 2 . In drawing 2 , the part enclosed with a broken line is equivalent to a resolution transducer. 200 in drawing is the input terminal of low resolution information, and the window information shown in 201 is inputted.

[0033] In 201, the part which Pixel E is an attention pixel and surrounded with the alternate long and short dash line is a window containing the near pixel which is an attention pixel. The information inputted from the input terminal 200 is transmitted to the linear interpolation section 202. The example of the information by which linear interpolation was carried out is shown in drawing 3 . Linear interpolation processing should just perform linear interpolation based on an attention pixel, the near pixel, and a distance in the meantime. For example, what is necessary is just to calculate the interpolation value of the main pixel E, the near pixels A, B, and D, and each interpolation pixel of the field surrounded by distance in the meantime at E, A, B, and D in the example of drawing 3 .

[0034] In drawing 3 , the part which the broken line showed the block boundary centering on each low resolving pixel, and was surrounded as the continuous line is the block over the attention pixel E. Moreover, O mark shows the pixel (observation pixel) of low resolution information, and x mark shows the interpolation pixel. Moreover, as for the low resolution information inputted from the input terminal 200, the maximum (MAX) in a window and the minimum value (MIN) are detected by the MAX/MIN detecting element 203. The maximum information and minimum value information which were detected are transmitted to the threshold decision section 204, and the threshold for quantizing on two sorts of gradation level is determined. With the gestalt of this operation, the following formulas determine a threshold (TH).

[0035] It is transmitted to the binary-ized section 205, and the threshold information

determined TH= (MAX+MIN) / 2, and maximum information and minimum value information make binary interpolation information on a block centering on the attention pixel E to which linear interpolation was given. It is transmitted to the substitution section 206, and a binary-ized result assigns maximum to the interpolation pixel (bigger interpolation pixel than a threshold) whose binary-ized result is "1", and assigns the minimum value to the interpolation pixel (interpolation pixel smaller than a threshold) which is "0." As 207 shows an output terminal and showed it to 208, the image which makes binary the maximum mentioned above and the minimum value is outputted.

[0036] Although the above processing is processing mainly performed to an edge part, it will become the image quality of a pictures tone with little gradation nature at parts for a flat part, such as a natural image, with the image of 2 gradation assigned at the above-mentioned maximum and the minimum value. In this case, the good resolution conversion without interpolation dotage is realizable with composition by the accommodative allocation ratio of linear interpolation information (print-out from the linear interpolation section 202), and the image information (print-out from the substitution section 206) of 2 gradation assigned at this maximum and the minimum value. In addition, the approach indicated by Japanese Patent Application No. 5-244737 should just be used for the detailed art of the synthetic approach by this accommodative allocation ratio.

[0037] In addition, this resolution conversion may be computed by the operation, and you may ask for it by LUT (look-up table). Now, definition of image information which carried out resolution conversion of the input image at nxm times improves. And next, in order to express gradation nature, false halftone is processed. Since image size has already doubled nxm by resolution conversion, (N/n)x(M/m) twice are enough as the expansion by the concentration pattern method. The matrix size by the concentration pattern method is [sake / on a gradation disposition] effective also by the well-known approach which did not need to differ from a dilation ratio and used the submatrix.

[0038] Thus, by the binary printer which has the printer engine of high resolving rather than input resolution, if the gestalt of this operation is used, it becomes possible to separate and consider the resolution transducer 103 and the gradation sexual expression section, and the optimization design of the value of n and m according to a printer engine property and human being's vision property can be realized. Moreover, the design in consideration of factors, such as cost and speed, is also possible.

[0039] A point for it to be careful with the gestalt of this operation is a point whose definition must improve rather than input resolution in the pixel made into nxm times in a resolution transducer. It is because it will completely become equivalence with a NxM twice as many concentration pattern method as this if it assumes that the zero-order interpolation which increases the number of pixels was merely used for nxm times instead of the resolution transducer.

<Gestalt of the 2nd operation> drawing 4 is the important section block diagram showing the gestalt of operation of the 2nd of this invention. In addition, in each drawing explaining

the gestalt of this operation, the same section as drawing 1 is received and the same number is attached.

[0040] First, the image information inputted from the input terminal 100 is made to store in a line buffer 101 temporarily, and the window which consists of a pixel group of the attention pixel circumference which is a processing object is created in the windowing section 102. or [that 400 contains an edge part in the image in a window from the condition of the pixel value in a window] -- it is the evaluation section which evaluates whether it is a part for a flat part. The edge detection filter used conventionally is used for this evaluation section 400.

[0041] a book -- operation -- a gestalt -- **** -- this -- evaluation -- a result -- being based -- resolution -- a transducer -- depending -- a scale factor -- it is -- n -- ' -- m -- ' -- a value -- dynamic -- changing -- making -- things -- the description -- it is . n' and the range which m' can take are as follows.

n' and m' need to be 1 for an integer of N and M respectively like the gestalt of $1 \leq n' \leq N1 \leq m' \leq M$ and operation of drawing 1 .

[0042] The resolution transducer 401 inputs the value of n' determined by the evaluation section 400 and m', and performs resolution conversion n'xm' twice. Like the resolution transducer 401, the value of m' is inputted and the concentration pattern section 402 performs n' and transform processing based on a twice (x (N/n') (M/m')) as many concentration pattern method as this. In processing with the gestalt of this operation, a different point from the gestalt of operation of drawing 1 has the description in the ability to carry out adjustable [of the dilation ratio accompanying resolution conversion for the ratio of the dilation ratio for expressing gradation nature] to arbitration with the property of an image.

[0043] That is, since the large dilation ratio (n', m') accompanying definition is taken and resolution is made light of in a flat part, it is made for the value of (n', m') to become small in the edge section, even if some gradation nature falls victim. Next, it is based and this actual example of processing is explained for drawing 5 and drawing 6 . It explains by the case (N=M=16) where an input image is expanded and outputted to 16 time x16 time as an example. The case where this inputs the image information of 75dpix75dpi into the engine of the binary printer of for example, 1200dpix1200dpi corresponds.

[0044] Drawing 5 (a) shows the window of low resolving information, and the pixel enclosed with the double plate of a center section shows the attention pixel. Suppose processing of this attention pixel that it was judged with an edge part being included and it was decided by the evaluation result of the evaluation section 400 that it would be n'=4 and m'=4. Drawing 5 (b) shows the attention pixel by which resolution conversion was carried out to the size of 4x4. Although the attention pixel value in the input image of a low resolution is "20", as shown in drawing 5 (b), two or more hidden edge is formed for the pixel with the value of "170" which is one contiguity pixel value by the resolution transducer 401.

[0045] Drawing 5 (c) shows the result from which processing in the concentration pattern section 402 was performed to the pixel created by (b) by twice (N/n') x (M/m') twice, i.e., 4

time x4 time. Drawing 6 (a) shows the window of a low resolution similarly. Suppose that the evaluation section 400 judged with the flat part, and it was decided by the evaluation result about the attention pixel of this window here that they would be n'=1 and m'=1. In this case, without performing processing by the resolution transducer 401, processing in the twice [twice (N/n') x (M/m')], i.e., 16 time x16 time, as many concentration pattern section as this is performed by the concentration pattern method, and the image of drawing 6 (b) is generated as a result.

[0046] Even if it compares drawing 5 (c) and drawing 6 (b), outputs differ greatly so that clearly. Only by making into an ecad the matrix of the concentration pattern proposed conventionally, it is impossible to output the image of such drawing 5 (c).

<Deformation of gestalt of the 2nd operation> drawing 7 is the modification of the gestalt of the 2nd operation, and is the block diagram showing the interior of the evaluation section 401 of drawing 4 . This example estimates with a precision more sufficient than the gestalt of the above-mentioned operation, and they are n' and the thing currently reflected in calculation of the value of m'.

[0047] In drawing 7 , the part enclosed with a broken line shows the evaluation section 401. 701 shows the input section and the window information surrounding the attention pixel of low resolving information is inputted. 702 shows a MAX/MIN detecting element and detects the maximum in a window, and the minimum value. the difference of the maximum which 703 showed the contrast calculation section and was detected, and the minimum value -- a value is computed. 704 -- n' and m' -- the difference which showed the decision section and was computed -- the value of n' according to a value and m' is determined.

[0048] this example -- difference -- n' and the point which enlarges the value of m' are the descriptions, so that a value becomes large. Drawing 8 shows the related example of n' determined as contrast. n' is made a setup which changes from 1 to N, so that contrast becomes large, since it is set to 1 <=n'<=N as mentioned above. Namely, the importance of resolution conversion gives priority to definition over improvement in increase and gradation nature, so that an edge becomes large.

[0049] Moreover, since the edge information created for subsequent false halftone processing will not be completely reflected even if it created the edge of high resolving by resolution conversion if it is the edge of the small halftone of contrast, it is effective to change the weight of definition and gradation nature gradually like the gestalt of this operation.

<Gestalt of the 3rd operation> drawing 9 is the block diagram showing the gestalt of operation of the 3rd of this invention. The gestalt of this operation simplifies the gestalt of operation of drawing 4 , has given the same number to the same section, and explains only a different part.

[0050] 900 shows the resolution transducer which performs resolution conversion by immobilization N time x M times. If input is A bits/pixel as mentioned above, after resolution conversion will become [pixel] in A bits /. 901 shows the dither section and

makes binary A bits [/pixel] information after resolution conversion with a dither method. 902 shows the concentration pattern section of immobilization N time x M times.

[0051] 903 shows a switch, and if are judged with an edge part being included as an evaluation result of the pixel value of the window from the evaluation section 904 and a generator terminal will be judged as a part for a flat part, it will choose a battery terminal. That is, if an edge part is included and it will be a part for a resolution conversion + dither method and a flat part, a concentration pattern method will be chosen. With the gestalt of this operation, when it puts in another way using the value of m', the description is [n' of the gestalt of the above-mentioned operation, and] that it makes the value of n' and m' only two kinds. That is, if it judges with the evaluation section 904 containing an edge part, and it is n'=N, m'=M, and a flat part, it will be decided that it will be n'=1 and m'=1.

[0052] According to the gestalt of this operation, processing speed is quick and good image quality which a jaggy does not generate can be realized into an edge part. As mentioned above, although resolution conversion + false halftone processing has been explained, it cannot be overemphasized that the gestalt of this operation is applicable to a monochromatic printer or the printer of a color. What is necessary is just to perform with the application of the gestalt of this operation for every color component in the case of a color printer.

[0053] Next, with reference to drawing 10 , the operation gestalt of the hardware configuration which performs the gestalt of each operation mentioned above is explained. Drawing 10 shows the outline of the hardware of this image processing system, and 1200 is CPU and controls the whole image processing system here. Moreover, 1202 is read, interpreted and performed by CPU1200 including ROM in which the image-processing program which described the procedure of each processing section mentioned above is stored. Moreover, also including RAM, since [as a working area for said program execution] image data and a processing result are stored, it is used for memory 1202. Moreover, the line buffer 101 is assigned to a part of this RAM field.

[0054] A keyboard 1203 and a pointing device 1204 are input terminals which input the command to this image processing system, and data. As for the display monitor 1201, an input command and a processing result are displayed. Next, with reference to drawing 11 , an example of the layout of each processing program stored in memory 1202 is explained. Each [these] processing program is read, interpreted and performed by CPU1200.

[0055] The window creation program 1101 is a program which performs processing which cuts down the image of a window size from the multiple-value image of the origin in the windowing section 102 of drawing 1 R> 1 and drawing 9 . The resolution conversion program 1102 is a program which described the procedure of performing each processing by drawing 1 , the resolution transducer 103 of drawing 2 , the resolution transducer 401 of drawing 4 , and the resolution transducer 900 of drawing 9 mentioned above.

[0056] The concentration pattern conversion program 1103 is a program which described the procedure of performing each processing by the concentration pattern transducer 104 of drawing 1 , the concentration pattern transducer 402 of drawing 4 , and the

concentration pattern transducer 902 of drawing 9 mentioned above. The evaluation processing program 1104 is a program which described the procedure of performing each processing in the evaluation section 400 of drawing 4 , the evaluation section 401 of drawing 7 , and the evaluation section 904 of drawing 9 mentioned above.

[0057] The dithering program 1105 is a program which described the procedure of performing each processing in the dither section of drawing 9 mentioned above. The MIN/MAX detection program 1106 is a program which described the procedure of performing each processing in MIN of drawing 7 , and the MAX detection section mentioned above. The contrast calculation program 1107 is a program which described the procedure of performing each processing in the contrast calculation section of drawing 7 mentioned above.

[0058] They are n' and the program m' decision program 1108 described n' and the procedure of performing each processing in m' decision section mentioned above to be. In addition, this layout is an example and it cannot be overemphasized that those configuration sequence may differ. In addition, even if it applies this invention to the system which consists of two or more devices, such as a host computer, an interface, and a printer, it may be applied to the equipment which consists of one devices, such as a copying machine. Moreover, it cannot be overemphasized that this invention can be applied also when attained by supplying the program stored in a system or equipment at the storage. In this case, the record medium which stored the program concerning this invention will constitute this invention. And by reading the program from this record medium to a system or equipment, the system or equipment was defined beforehand, and carries out, and it operates in the direction.

[0059] As explained above, in case it changes into the binary image information of high resolution from the inputted multi-gradation image information of a low resolution according to the gestalt of this operation, good conversion of the image quality in which there are few loads at cost and the point in processing speed, and does not have a jaggy, and the edge clarified can be processed efficiently. Moreover, the optimization design doubled with the property and vision property of printer engine is attained.

[0060]

[Effect of the Invention] As explained above, according to this invention, it is efficiently convertible for the binary image of image quality with which there is no jaggy and the edge clarified the multi-gradation image with the low resolution with low cost and a low load.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the block diagram showing the gestalt of operation of the 1st of this invention.

[Drawing 2] It is the block diagram showing the resolution transducer of drawing 1 .

[Drawing 3] It is the explanatory view showing the linear interpolation of drawing 2 .

[Drawing 4] It is the block diagram showing the gestalt of operation of the 2nd of this invention.
[Drawing 5] It is drawing showing the example of processing of the edge part in the gestalt of the 2nd operation.
[Drawing 6] It is drawing showing the example of processing for a flat part in the gestalt of the 2nd operation.
[Drawing 7] It is the block diagram showing the evaluation section of the modification of the gestalt of operation of drawing 2 .
[Drawing 8] It is drawing showing an example of the relation of n' determined as contrast.
[Drawing 9] It is the block diagram showing the gestalt of operation of the 3rd of this invention.
[Drawing 10] It is drawing showing the hardware configuration of the image processing system of the gestalt of operation of this invention.
[Drawing 11] It is drawing showing the layout of each processing program stored in memory 1202.
[Description of Notations]
101 Line Buffer
102 Windowing Section
103 Resolution Transducer
104 Concentration Pattern Section